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POWER MISCELLANY

MARCH, 1938

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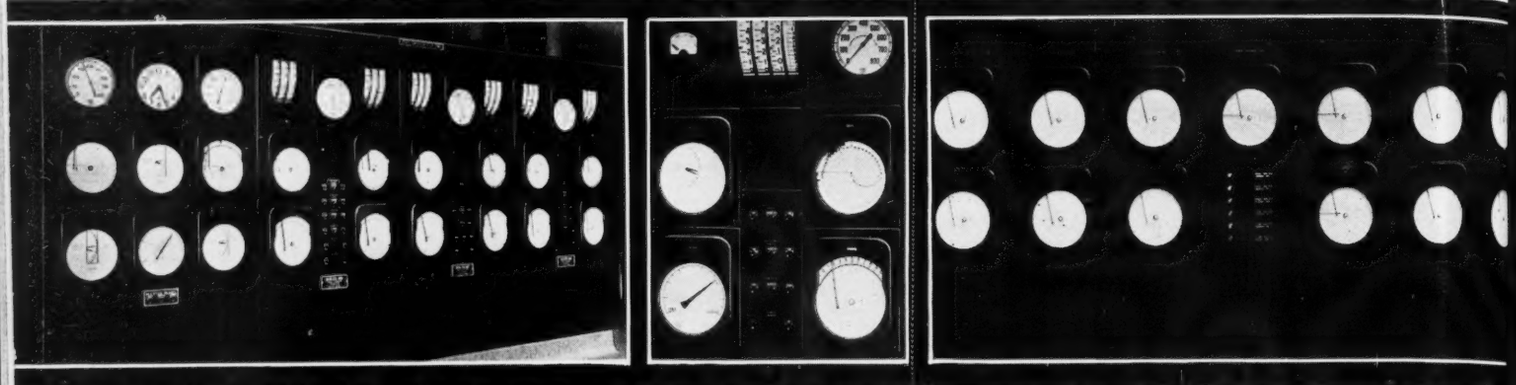

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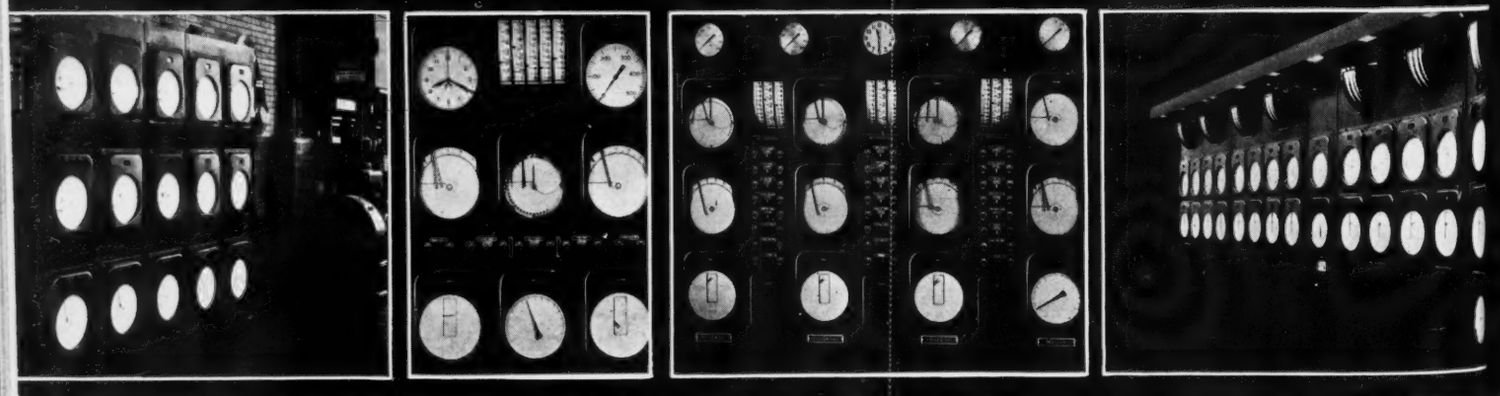

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POWER

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Diesel Future

ENTRY of General Motors into mass production of diesel engines (page 132) is a technical event of major importance. It bids us reconsider the future position of the diesel in the national power economy.

For at least four years *Power* has been saying editorially that the main objectives of diesel progress should be increased reliability, less maintenance, easier servicing and lower first cost. For a solution along these lines we predicted an extension of the mass-production methods that made the automobile, and then the diesel tractor, so successful. We felt that the automotive demand for truck and bus diesels would provide the needed mass market and thereby permit cheap production of a small diesel suited for stationary applications as well.

In principle, the General Motors' venture fits this picture exactly. Pending actual field experience, we cannot say to what extent this particular engine will meet the requirements of stationary power. On the other hand, we do expect that several manufacturers, building highly standardized engines in the automotive size range and according to the philosophy just outlined, will solve the problem of first cost, maintenance and servicing. We expect the early development, on a mass production basis, of several makes of small low-cost diesels, available as inexpensive packaged power units "off the shelf", with ample servicing facilities (including spare parts) in all large centers.

Now for the other side of the picture! When the man in the street notes all this excitement about diesels he imagines that steam is on the way out. In this he is certainly wrong. The packaged units will replace steam in many specific instances within narrowly defined fields, but the general idea of diesel replacing steam is a day dream. To show this more clearly, let's take up present steam-power fields one at a time; first central stations:

With present relative costs of coal and diesel oil, the diesel cannot approach steam fuel costs in large central stations. Moreover, the possible future gains in efficiency, and the probable trend in relative fuel prices, both favor steam. On the other hand, some future encroachment of the diesel is to be expected in small central stations (5000 kw and under), serving isolated communities.

Going to the other application extreme, we must consider the thousands of small independent establishments, such as garages, machine shops, small office buildings, etc. Very few of these now find it profitable to operate steam prime movers. In general, they buy power and run boilers for heating. They must continue to operate heating boilers. Whether they will continue to buy electricity, or turn to local generation with low-priced diesels, will depend on many factors beyond our capacity to predict—notably future cost of diesel fuels, future electric rates, and such matters as convenience, engine space and exhaust disposal.

From these very small establishments we turn to larger factories, buildings and institutions with heavy heating and process loads. All have extensive boiler equipment and must, in any case, continue to use boilers. Many have steam prime movers, as well, but generally only where the power load can be generated mainly as a byproduct for at least six months of the year.

Burning six-dollar coal under the worst boiler-room conditions, the fuel cost of true byproduct power is not over 1½ mils per kw hr. With oil at 6 cents per gallon, diesel fuel will cost about 5 mils per kw hr. Since boilers are needed in any case, the fixed charges of byproduct power are little more than those of the engine room alone, giving a figure far below present diesel-plant fixed charges.

Yet the diesel gets its chance here whenever the heating and process load will not generate the entire power demand as a steam byproduct. Then the fuel cost of steam power may jump well above that of diesel power, justifying a diesel installation for standby and summer use, and perhaps to generate part of the winter load as well. In such a combination each type of unit also serves as an emergency standby for the other. Finally, the diesel should have very wide application as a drive for pumps, compressors, refrigerating equipment, etc.

This is our attempt to paint an honest picture of the diesel situation for the immediate future. Looking ahead 15 or 20 years, the situation should be more favorable to steam. With vastly greater reserves, coal (and its products) is certainly the ultimate power fuel. The diesel must eventually face a new handicap as growing scarcity of petroleum and growing demands for marine, automotive and household oil, widen the price spread between coal and diesel fuel.

—Philip Swain, Editor

How Six Industrials Control Tops

Whether your plant is large or small, whatever the hook-up or steam conditions, you can learn something useful from the many control arrangements used in these leading industrial topping installations

BY CHESTER R EARLE
Engineer, Republic Flow Meters Co.

HIGH pressures and high temperatures have come to stay in industrial power plants, bringing with them new problems in operating superposed turbines and regulating different pressures in two or more steam-piping systems. A few years ago, if an industrial plant needed 150-lb steam for process work, boilers were installed to generate it at the desired pressure. Now, many plants are supplying steam for process up to 400-lb pressure by extraction or exhaust from high-pressure turbines.

These plants have a great variety of hook-ups. Back-pressure and condensing turbines, high-pressure boilers for baseload, and older low-pressure boilers for standby, must operate together smoothly if actual economies are to be realized from high-pressure steam conditions. Furthermore, there must be no shutdown of process equipment. Hence, there is a real need for reliability of control equipment and close coordination of plant operation. Controls should be automatic wherever possible because manual adjustment cannot hold conditions as steady when swings occur in process demands.

The control problem for industrial plants is different from that for central stations in several important aspects. A shut down of the high-pressure unit in either case can involve the low-pressure machines and result in a large loss of capacity unless a reducing-valve and desuperheater bypass is ready for instant use. For industrial tops, however, the bypass is commonly operated during normal load conditions to make up for deficiencies in low-pressure steam and provide better pressure regulation. Industrial boilers are often installed in anticipation of future loads and must operate in the meantime for long periods at low loads. Such operation presents a difficult problem in boiler-combustion control.

Control problems can perhaps best be illustrated by considering a number of actual cases. Six typical industrial topping plants are shown diagrammatically in the accompanying figures (Figs. 3 and 4 cover same plant). Represented are several arrangements of high- and low-pressure turbines and various process-steam pressures. Since different types of firing equipment and different boiler and auxiliary layouts are included, practically all the fundamental control problems have been met in one or another combination.

All the plants are alike in that constant steam pressure is maintained in the high-pressure boiler and in that the topping turbines are used to produce as much byproduct power as possible. In general they all provide for maximum use of the newer high-pressure boilers, the efficiencies of which are appreciably higher than existing or older low-pressure units. Pressure inexhaust and low-pressure headers is held constant to avoid affecting processing procedures.

In the plants shown here, the boilers are under full-automatic combustion control by systems in which a master controller, actuated by variations in main-steam header pressure, sends impulses to regulators. The regulators, in turn, control dampers, valves and the like. Both fuel supply and air

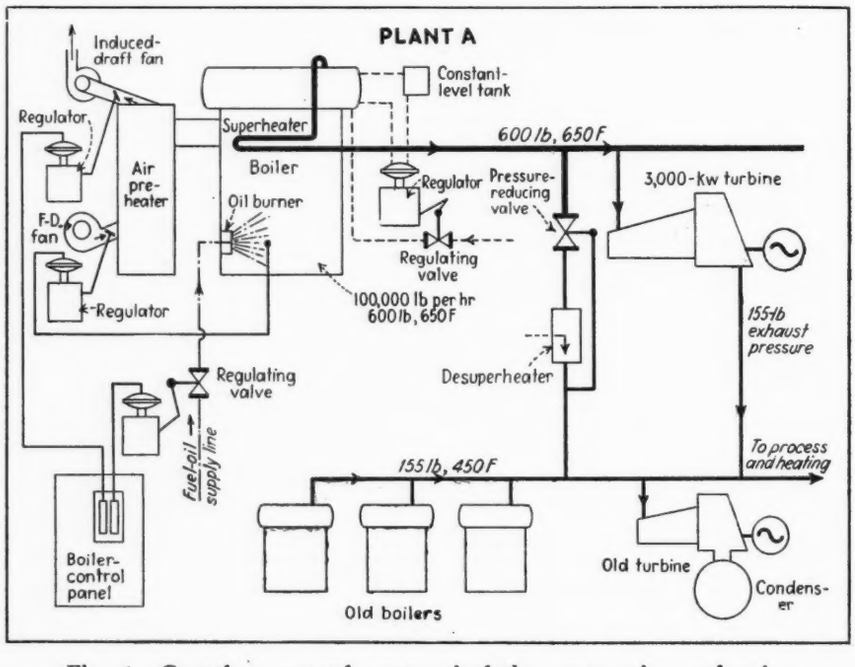


Fig. 1—Complete control system includes automatic combustion control, feedwater regulation and pressure-reducing bypass with desuperheat

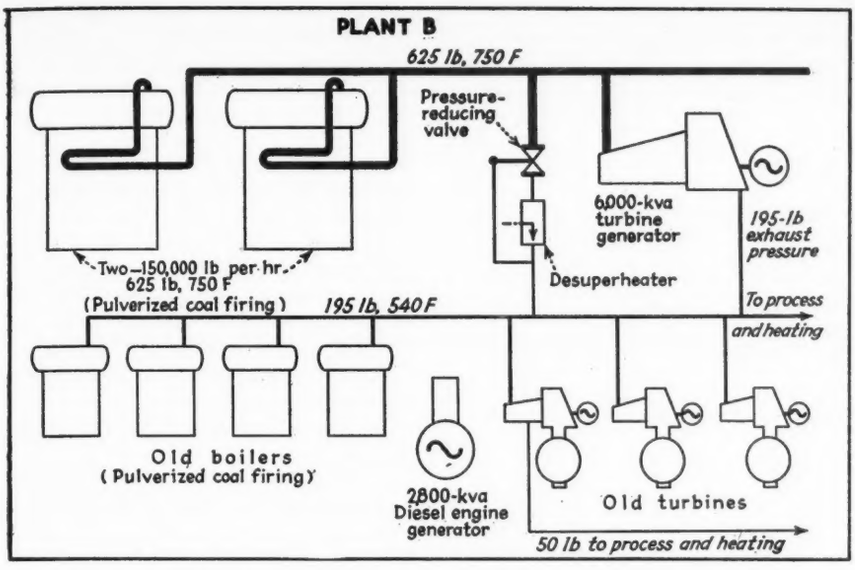


Fig. 2—Combustion control is automatic in this private central station. A diesel helps balance steam and power loads

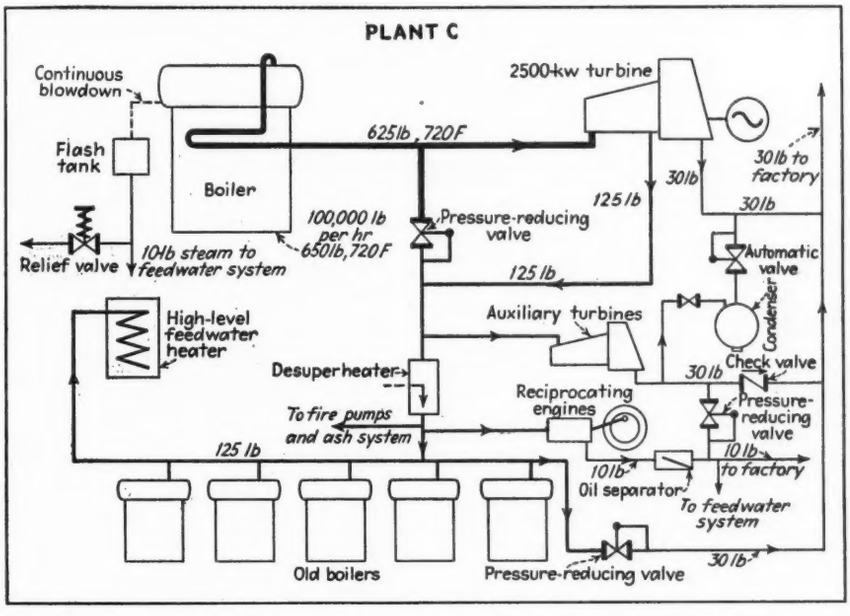


Fig. 3—Coordinated controls regulate four pressure systems in this plant. An auxiliary condenser is cut in only when needed

for combustion are, of course, controlled in proper quantity and ratio and constant furnace pressure is maintained. These effects are, however, accomplished in a variety of ways.

Fuel Regulation

In Plant *A*, Fig. 1, for example, the fuel regulator controls the supply of oil by a regulating valve in the line just ahead of the burners. In Plant *B*, Fig. 2, pulverized coal is supplied to each boiler by two mills and the amount of coal fed to the mills is governed by a device based on the coal level in the mill. Air supplied to the mill governs the rate of fuel feed to the burners and therefore a damper in the primary-air duct leading to the mill regulates load. Pulverized coal is also burned at Plant *C*, Figs. 3 and 4, and here too the fuel regulator controls primary air to the mills by operating a damper.

At Plant *D*, Fig. 5, the high-pressure boiler is fired by an underfeed stoker. Rate of coal feed is controlled by regulating the steam-control valve of the stoker turbine. Plant *E*, Fig. 6, is also stoker fired, but the stoker is controlled by varying the setting of the stoker-motor rheostats.

In Plant *F*, Fig. 7, a pulverized-coal installation, fuel supply is adjusted by varying the speed of the pulverizer feeders as well as by dampers controlling primary air. In some cases air pressure in the pulverizing mill must be held constant. This is accomplished by a separate regulator responsive to the mill pressure only.

Pulverizer controls are frequently designed, as at Plants *B* and *C*, to work with electrical interlock systems to insure proper sequence of operation and shut down equipment on failure of certain factors. Frequently, controls are built into the pulverizing mills by the manufacturers and combustion-control equipment must not interfere with their functioning.

Control of air and flue-gas flow through a boiler is by damper operation or variation of fan speed. At Plants *A* and *D*, the air-flow regulator operates dampers just ahead of the induced-draft fan. At Plant *B*, flow is controlled by throttling steam to the fan turbine. Dual drive of forced- and induced-draft fans by motor and turbine at Plant *C* requires two regulators. One actuates forced- and induced-draft dampers and the other controls turbine speed by valving the steam flow. An electric device varies the turbine-drive regulator loading. Still another regulator operates to maintain constant pressure drop across the cyclone dust collectors. At Plant *E*, induced-draft-fan speed is controlled by throttling steam to the fan turbine while at Plant *F*, air-flow regulators operate motor rheostats.

Back-Pressure Tops

Plants *A* and *B* show industrial applications of the high-pressure topping turbine of the back-pressure type, with no extraction, exactly as in a central station. Plant *A* contains one new 100,000-lb-per-hr oil-fired boiler supplying steam at 600 lb, 650 F to a new 3000-kw turbine-generator which exhausts at 155 lb, 450 F to existing equipment. The old plant consisted of five boilers supplying steam to condensing turbines and to factory process. A short time ago, two boilers had to be shut down, leaving the plant short of steam. A high-pressure top not only replaced the lost capacity but increased total capacity. It also has reduced steam and power costs by making 80 to 100% of the electric power by back-pressure generation, instead of by condensing generation, and has given a much better balance between steam and power loads. The operating layout is more flexible and maximum efficient use of existing equipment is made, with minimum building changes and minimum interference with process during installation of the new equipment.

The new high-pressure boiler and the topping turbine will normally operate on pressure control and the low-pressure condensing turbine on speed control to take load swings. The three remaining 155-lb boilers will

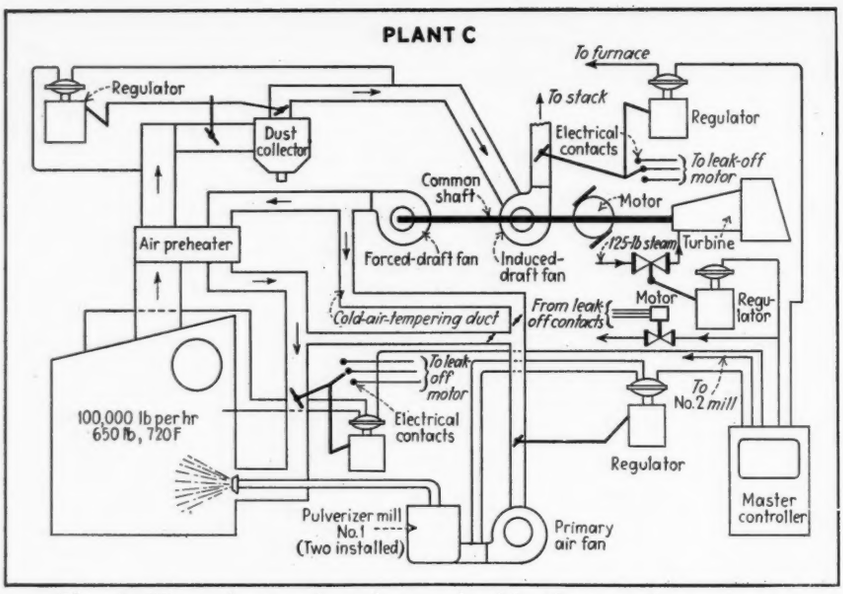


Fig. 4—Unusual control equipment in this plant on the common-shaft motor-turbine fan drives

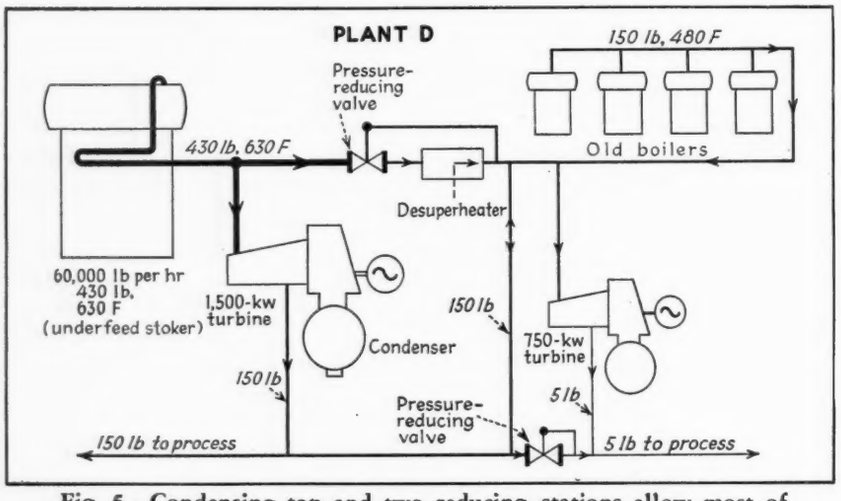


Fig. 5—Condensing top and two reducing stations allow most of the load to be carried by the topping turbine. Combustion control is automatic

float on the line to make up any difficiency of steam in the low-pressure system. Full-automatic control of all equipment is essential. Steam pressure must be maintained constant in the high-pressure boiler, otherwise the operation and capacity of the topping turbine will be affected. Accordingly, the automatic-combustion-control system must afford close control without hunting, yet must be prepared for any sudden surge caused by fluctuations in the process requirements. The high-pressure-turbine load is ordinarily quite steady. The pressure-reducing and desuperheating station will operate as a bypass when the turbine is shut down, but normally is in parallel with the turbine to pass additional steam to the low-pressure system. The latter operation is required only when low electric load does not permit the turbine to meet the low-pressure steam demands. With the entire high-pressure plant automatically controlled, the operating staff is free for the important duties of supervision.

Plant *B* has essentially the same topping arrangement as Plant A. The topping turbine operates primarily as a reducing valve making byproduct power. The plant itself, however, is a private central station serving a large group of industrial plants with electric power and process steam. Before the topping unit was added, the plant consisted of ten longitudinal-drum boilers fired by unit pulverizers and making steam at 200 lb, 540 F. This steam was supplied to three condensing turbine-generators, from one of which steam is extracted at 50-lb pressure for heating and process work. A 2800-kva diesel set was installed a few years ago to maintain better balance between steam and power loads.

The new topping unit consists of a 6000-kw turbine-generator for which two new pulverized-coal-fired boilers, 150,000 lb per hr each, supply steam at 625 lb, 750 F. The turbine exhausts directly to the existing low-pressure header.

A feature of the combustion control is the safety regulator operating electrical contacts, so connected with an electrical interlock system that the combustion equipment will shut down in case furnace pressure rises above a predetermined value.

In Plant *C*, Figs. 3 and 4, the new high-pressure boiler is now the main steam supply for the plant, the low-pressure boilers floating on the line. Four separate pressure systems supply steam for power generation, heating and process. The boiler-control system incorporates unusual features and a complete system of electrical interlocks insures correct sequence of operation of the boiler auxiliaries under all conditions.

One for Five

In the original plant, five stoker-fired boilers supplied steam at 150 lb for process and heating. Electric power was purchased from the local power utility. The new topping plant, just put in operation, consists of a 100,000-lb-per-hr, 650-lb, 750 F integral-furnace boiler fired with pulverized coal.

Four pressure systems are shown ing Fig. 3: 650 lb, 750 F for power generation; 125 lb for auxiliary drives on fans, pumps and air compressors, also for high-level feedwater heating; 30 lb for heating and process; 10 lb for heating and for the feedwater system. Extraction steam at 125 lb from the turbine is available up to a maximum flow of 90,000 lb per hr. The 30-lb system is supplied from the main 2500-kw turbine exhaust. The 10-lb steam comes from exhaust of auxiliaries and flash from the continuous blowdown system. These pressures are under control of three pressure-reducing valves and a spray-type desuperheater. If the steam demand in any system rises above normal, pressure is maintained from the next higher system. The condenser, operated only in summer and designed for a maximum condensing capacity of 35,000 lb per hr, utilizes well water. In case of unusual disturbance, this condenser is cut into the 30-lb system automatically by a pressure-operated valve.

Old boilers are used for peak loads. No power standby is provided; power in excess of byproduct generation is purchased from the local utility. Outage of the new turbine throws the en-

tire load to the utility, but during outage of the high-pressure boiler, the turbine can produce about 1000 kw from 125-lb steam supplied at the extraction point.

Forced- and induced-draft fans are mounted on the same shaft, driven on one end by a motor for low loads and on the other end by a steam turbine for heavy loads. Connections of the combustion control to maintain a constant pressure drop across the cyclone dust collectors are shown in Fig. 4.

Both fans are mounted on the same shaft and consequently revolve at the same speed. They are regulated both by dampers and speed. Cutting in and out individual cyclones requires readjustment of the loading pressure of the fan regulator in relation to the regulators of secondary-air and furnace pressure. The operating cylinders of air and gas dampers have electrical contactors connected to a small motor that operates a leak-off valve in the master loading line to the fan-speed regulator. When these dampers approach their open or closed position, the motor is energized and the dampers kept within a range of 20 to 80% open. This combustion-control equipment is connected to an electrical interlock system so that the induced-draft fan must be started first. Then other auxiliaries are permitted to operate in proper sequence. Shutdown safety devices are also part of the system.

Room for Expansion

In Plant *D*, combination of a 1500-kw high-pressure condensing extraction turbine-generator with an existing 750-kw condensing extraction unit represents another type of modern industrial top. Steam was formerly generated at 150 lb, 480 F by three stoker-fired boilers. The new boiler, also stoker fired, has a capacity of 60,000 lb per hr at 400 lb, 630 F This boiler has complete automatic-combustion control and represents modern conservative industrial plant practice. The layout is simple and compact, little new building construction was necessary and there is room for future expansion.

Plant *E* contains two topping units operating at 900 lb, 750 F, each of 6250-kva capacity; the two boilers generate 180,000 lb per hr and 200,000 lb per hr respectively. These are of particular interest because of the 400-lb extraction pressure, unusual in industrial plants. Pressure-reducing valves and desuperheaters regulate conditions in the low-pressure system.

Plant *F* heads a group of extraction-condensing turbines with two 850-lb, 750-F units. The latter replace two old units and are connected to the old generators. Steam and power generating efficiency have been greatly increased. One of the two new 125,000 lb-per-hr pulverized-coal-fired boilers can carry the entire load in summer; both units are needed in winter, in effect replacing 24 old boilers now held as standby. By changing process-steam lines from 2 lb to 20 lb and designing the high-pressure and low-pressure turbine extraction points accordingly, it has been possible to increase the capacity of the existing factory distribution piping. At the former 2-lb pressure, it was not large enough to handle the load. Two pressure-reducing and desuperheating stations, between 850-lb and 175-lb and between 175-lb and 20-lb, supply steam automatically from the high-pressure boilers when demands for process steam exceed the amount that can be supplied from the turbine extraction points.

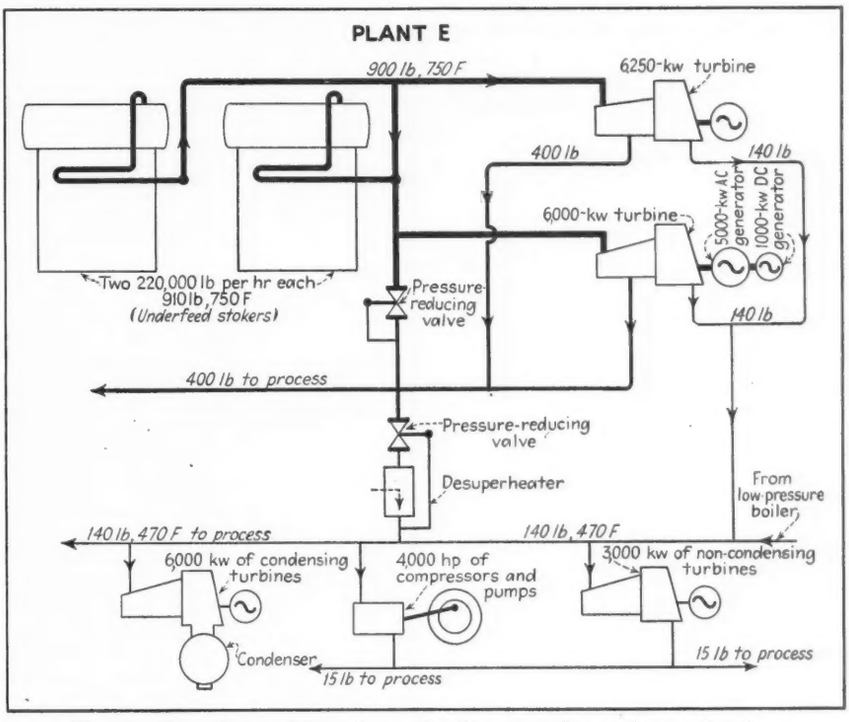


Fig. 6—Topping turbines have 400-lb extraction point and exhaust at 140 lb in this stoker-fired plant

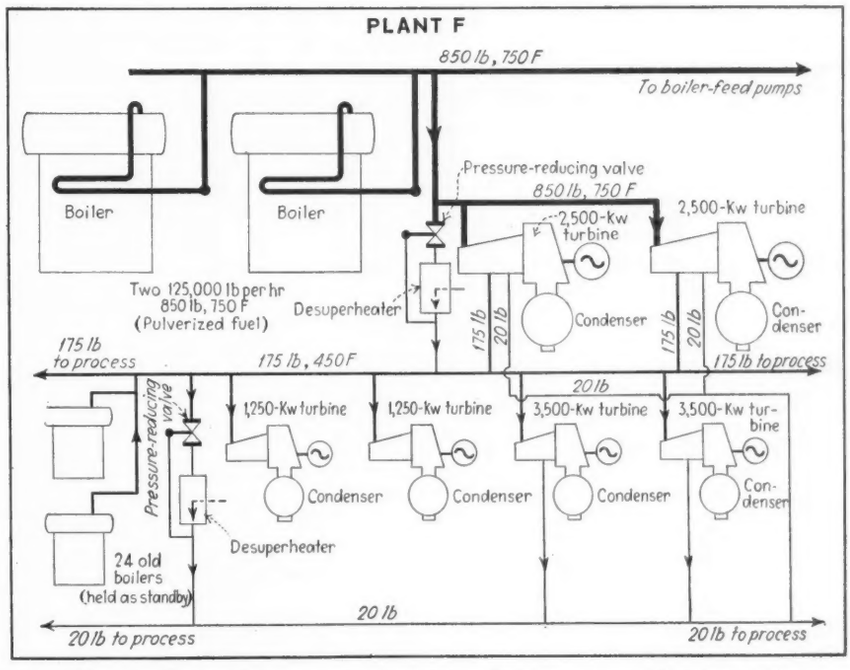


Fig. 7—Extraction at two pressures from new condensing units gives flexibility of process-steam supply

Fair Weather for Film Processing

Process and comfort air conditioning are vital to Consolidated Film Industries Inc's operations, so they control slime and algae in condenser and washer circuits to help insure reliabity

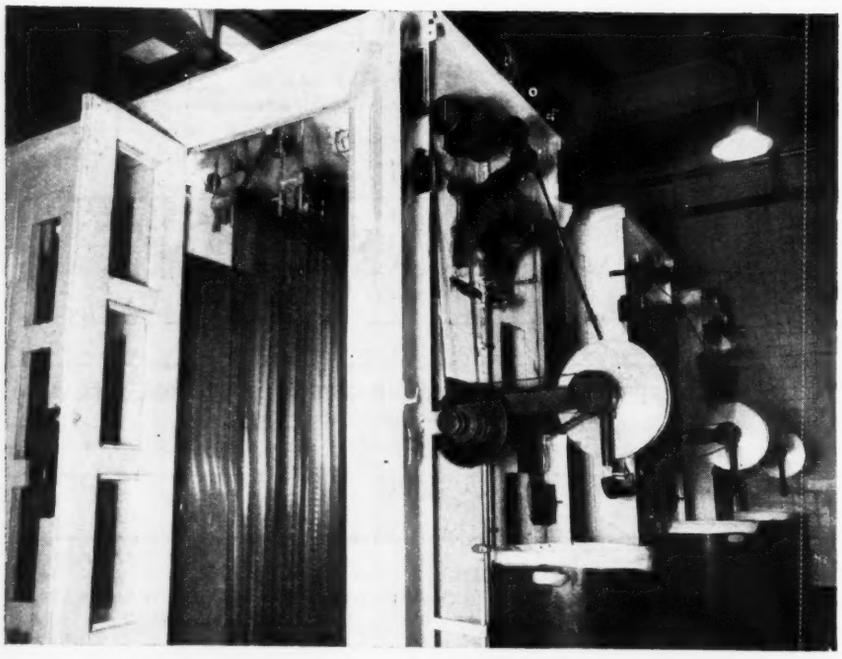


Fig. 1—Film-drying cabinets are supplied with air at 30% relative humidity. Wet film moves up and down over rollers, at high speed, winding up on reels in foreground. Only the ends of the cabinets are shown; each is about 30 ft long

UNFAILING 24-hour service is required of air conditioning equipment at the world's largest film-processing laboratory — Consolidated Film Industries, Inc, Fort Lee, N. J. In this modern plant prints are made from motion-picture negatives, for distribution all over the world. Operations are divided into two parts, known as Plant No. 1, and Plant No. 2, each having a straight process application of air conditioning and a comfort application. Four separate conditioning installations meet these requirements and a central refrigerating plant serves all four.

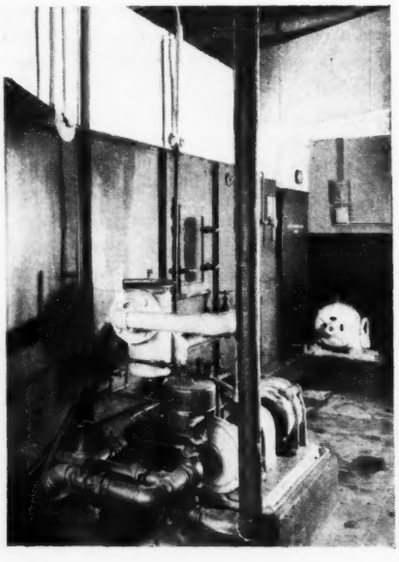
The straight process applications are in the film-drying rooms. Here the film, completely printed and fixed, but still wet, is run up and down at high speed through cabinets in which warm dry air is circulated. There are 14 such cabinets in Plant No. 1's two drying rooms, all supplied with air from under-floor ducts. This air is maintained at about 30% relative humidity and at a temperature that varies with the speed of the film. Cabinets are supplied from one of the four conditioning plants mentioned above, consisting of an automatic viscous filter, a York spray air washer, and a 28,000-cfm Sturtevant fan. Automatic control, set to maintain a dewpoint temperature of 50 F, regulates dampers which control the mixture of fresh and recirculated air entering the washer.

The single drying room in Plant No. 2, with six drying cabinets, is served by viscous cleanable unit filters, by a York air washer, and by a 22,000-cfm Sturtevant fan. Control is similar to that for Plant No. 1.

The remainder of the air conditioning is installed primarily for the comfort and health of the employees, but also pays dividends in improved processing resulting from clean air without extremes of heat or cold, dryness or moisture. In Plant No. 1, two printing rooms, two negative examining rooms, two negative cleaning rooms, a joining room and a timing room, are all served through overhead supply and return ducts from a third conditioning plant. Automatic viscous filters, a York air washer, and a 6000-cfm Sturtevant fan comprise this unit. Automatic-control equipment is set to produce approximately 74F dry bulb and 68F wet bulb, in the rooms.

In Plant No. 2, a small negative examining and cleaning room is conditioned, as well as a room in which continuous-process machines handle film from the negative right through to projection of the finished print. The drying cabinets for this continuous process are supplied separately from the Plant No. 2 drying-air system. The comfort conditioning unit consists of cleanable viscous unit filters and a Sturtevant washer and fan

Fig. 2—Comfort-conditioning air washer in Plant No. 2



of 10,000-cfm capacity. In general arrangement and control it is similar to the Plant No. 1 comfort conditioner.

Chilled water, maintained at an average temperature of 44 F, is supplied from an isolated refrigeration building, housing the compressors and coolers. Total capacity is 225 tons, made up of one 10x10 in., 300-rpm, 125-ton compressor, and one 8x8 in., 360-rpm, 75-ton unit, both York. Both are vertical, single-acting, two-cylinder, ammonia machines and are equipped with bypass valves for capacity control. The larger compressor is direct-connected to a 125-hp, 4150-volt, 3-phase, synchronous motor with induction starting, the smaller to a 75-hp motor of similar characteristics. All power is purchased.

The refrigerant condenser is a shell-and-tube unit and condensing water is cooled in a Marley forced-draft cooling tower located on the roof of the 1-story brick building housing the refrigeration machinery. The roof is used as a storage basin for the washer, having about 1000-gal. capacity. A 920-gpm pump circulates condensing water.

Ammonia is expanded in three shell-and-tube water coolers, chilling water for film-processing, for remote cooling of processing solutions, and for washer sprays. All water used in the plant is from the municipal supply, as no well water is available.

Winter Operation

Refrigeration equipment is operated only in the summer season. In the winter months, outside air is drawn through the conditioners where it is filtered, washed, and heated as required. The cold water needed for film processing and for cooling processing-solutions, is drawn from the conditioning-system water circuits by special pumps.

Growth of slime and algae in the water circuits of this system was a continual source of trouble, especially since any unscheduled shutdown would mean damaged film. In the cooling-water circuit, extensive algae growths were encountered in the cooling tower and on the roof basin, which was drained weekly. Slime formation in the condenser reduced heat transfer so effectively that in one case, just before cleaning, the head pressure rose to 235 lb, at which point the compressors could just barely carry the load. Cleaning would reduce this pressure to 195 lb, but more slime growth would start raising it immediately.

An even more critical condition was encountered in the air washers. Here bacterial growths, feeding on organic dusts in the air, particularly pollen from the nearby Jersey meadows, caused serious slime formation on the spray heads, and other parts of the washer. Particularly serious was the formation of slime on the screen over the suction opening in the washer bottom, since there was always the danger of losing suction on the pump with consequent outage of the conditioner. Too-wet air might result which would cause condensation on the raw stock, desensitizing it. If the air was too dry, static sparks would occur, exposing parts of the films. Thus continuous operation of the washer was absolutely necessary.

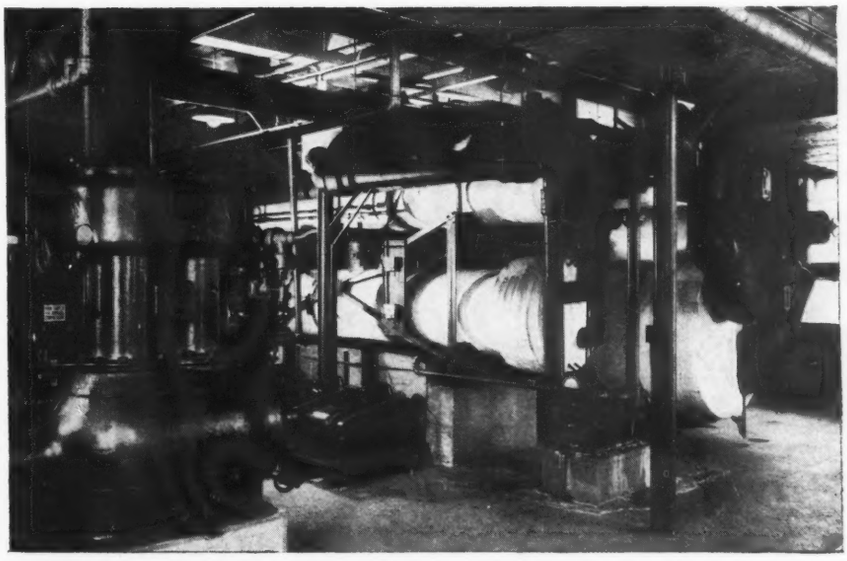
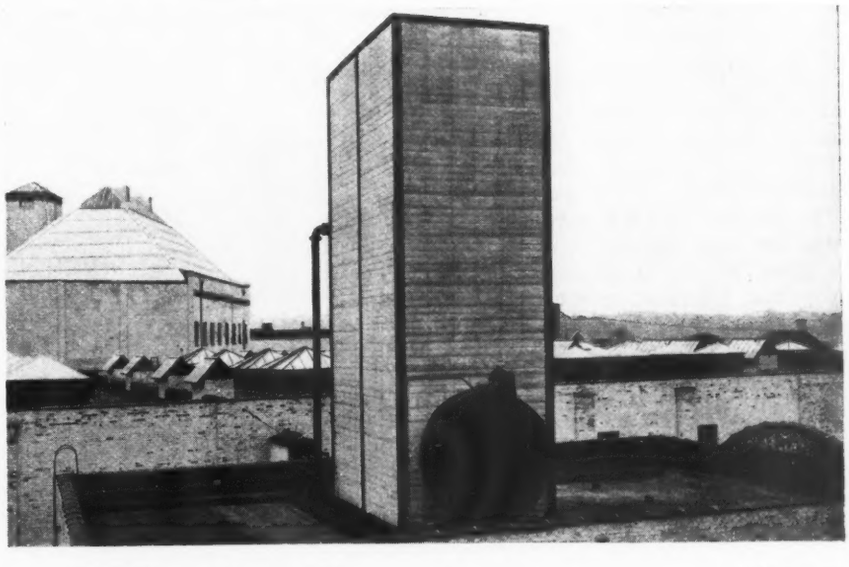


Fig. 3—150- and 75-ton ammonia compressors, condenser and water coolers in refrigeration room

These slime problems have been solved in recent months by "Oakite Airefiner", a bactericidal compound designed to do four jobs: (1) to prevent slime accumulations, (2) to insure that air leaving the washer will have as low a bacteria content as that entering the washer, (3) to prevent odors arising from bacterial action in the wash water, and (4) to prevent corrosion of metallic elements. Such a material must remain stable in solution, if it is to exert a continued prevention action.

Application of Airefiner in the cooling-water circuit for about three months before the winter shutdown left the condenser surfaces clean, and has eliminated algae in the cooling tower and on the roof. Its use for about six months in the water circuits of the air washers has kept them free of slime. The present weekly charge is about 2.75 lb, and a weekly check is made of the concentration of the solution and its effectiveness, to determine the accuracy of this charge. Recharging is necessary to make up for neutralizing of material by traces of sulphur in the air.

Fig. 4—Forced-draft cooling tower on roof of isolated refrigeration building. Roof is used as storage basin for tower



Kettering Talks Diesels

Here is the background of General Motor's new diesel, as told to the editor of POWER by Charles F Kettering, vice-president in charge of research, General Motors Corporation

EDITOR—POWER'S *readers are concerned with engines for stationary plants. In developing this new Detroit plant, I assume that General Motors' first thought was to produce diesels for trucks and buses. You have announced, however, that the standardized diesels, to be produced at Detroit in sizes from 22 to 160 hp, are available for any use whatever, including application to mechanical drive and the driving of generators, air compressors, refrigerating compressors, pumps, fans, etc. Let's call these "industrial diesels." Is there any difference between an automotive diesel and an industrial diesel?*

Kettering—"Basically none. You simply have a diesel engine. Of course some engines are too large and heavy for automotive use. On the other hand, if you make a suitable engine for automotive use, there is no reason why it isn't suitable for industrial applications without change."

Looking ahead a few years, would you venture to guess how the demand for automotive diesels will compare with demand for other applications?

"I wouldn't attempt to predict. Up to now there has been no such thing as an 'all-purpose diesel.' When something new is produced, you can never tell how far its applications will go. The designer's job is to give his product the right specifications to meet a great variety of situations. If he does that job right, he can let nature take its course."

For the time being, at least, I assume that mass-production methods cannot economically be applied to engines above 160 hp. Won't this mean that the small standardized engines will cost less per horsepower than the big fellows? And does this not logically lead right back to the old idea that you could build a 2000-hp or 3000-hp diesel plant cheaper by combining a lot of small engines than by using 3 or 4 big ones?

"Yes, to some extent, perhaps, but you can't generalize, Mr. Swain. It all depends. Generators, foundations, switching equipment, piping, muffler and so on will cost more broken into a lot of small pieces and this would put a limit on how far it would pay to go. In a lot of plants, I think it might pay to combine some large engines with some quite small to take care of all load conditions with the least investment and operating cost."

I am much interested in your new system of engine balance in which the crank arrangement allows the pistons to cancel their own secondary unbalance (due to the engularity of the connecting rod), while offset weights on two parallel camshafts near the top of the engine cancel the primary unbalance. Won't you need unduly heavy weights with the 1-cyl unit?

"No. By the way, this balancing system, as used on all the 71 Series engines, was hard to decide on because it is such a radical departure from usual practice. It is the logical way to balance the engine; has no reciprocating parts and adds almost nothing to cost of manufacture.

Why is this system so cheap and convenient, Mr. Kettering?

"Well, in the first case we needed two camshafts anyway in the upper part of the cylinder block, one for exhaust valves and one to operate the unit injectors. All we had to do was to incorporate the eccentric weights on these shafts. You may be inter-

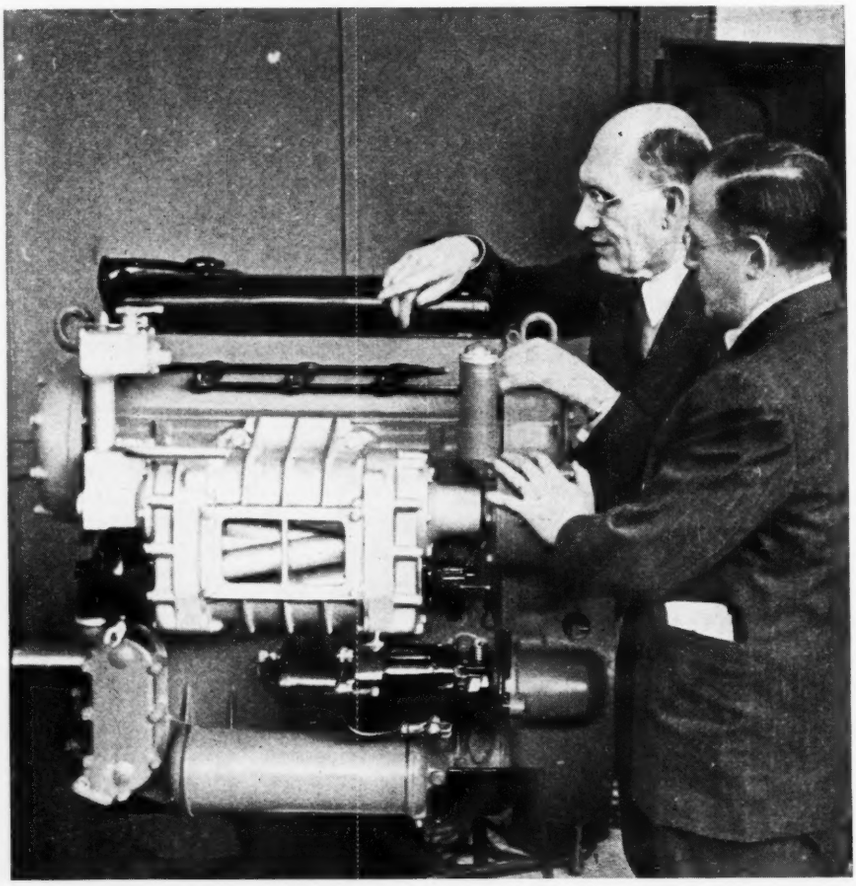


Fig. 1—Charles F Kettering and R K Evans of General Motors look over 4-cyl, 107-hp model *(Power Photo)*

ested to know that we are now trying out this same balancing system on a 12-cyl Vee railroad engine."

I note that your pistons are made of high-strength alloy cast iron? Why don't you use aluminum?

"Remember this is a 2-cycle engine, so there is no reversal of stress. This fact, plus the special balancing arrangement, means that the weight of reciprocating parts is not as important as in 4-cycle engines. In our large sizes we do use aluminum pistons."

Why did you select a lobed blower; why 3-lobed? Will it stay tight and quiet?

"A lobed blower is the only practical kind for this particular low-pressure service (about 5-lb pressure at 1800 rpm). Remember this blower is for scavenging, not supercharging. The 3-lobed is very much quieter than a two. We spiral the rotors for further smoothness and machine them accurately in a machine similar to a spiral gear shaper."

Why do you prefer the unit injector?

"It's the only way we know to do the job right, Mr. Swain. The stretch of piping and compression of oil are considerable at high pressures. For smokeless operation we must have atomizing pressures as high as 20,000 lb per sq in. The unit injector is the only practical way to get such injection pressures."

What is the lowest-grade fuel oil you will recommend for the Series 71 engines, Mr. Kettering?

"Any distillate; specifically plain domestic furnace oil, No. 1, 2 or 3."

The automotive demand for diesels is going to help the industrial diesel user by giving him a less costly engine and simplifying his service problem. At the same time, it's going to increase the demand for diesel fuel oil. Won't this raise the price of diesel oil, and hence his operating cost?

"I don't know."

You've probably heard about the proposed system for heating small buildings, or even houses, using a diesel engine instead of a boiler. The engine also supplies current for power and light. Waste heat is picked up from exhaust and jacket to heat the building. If this isn't enough, the load on the engine is raised and the excess power absorbed in an electric boiler or hot-water heater.

"In domestic sizes the idea is hardly practicable because of first cost. In larger installations, this method of combining heating and power generation is already being used, but it would not ordinarily pay to put in an engine much larger than needed to carry the straight power load. Beyond that you would use an oil-fired boiler or water heater. The electric boiler you mention is all right for many installations. In fact, we have one in our new laboratory out at the new diesel plant. It picks up energy from engines on test and turns it into plant heat. An oil-fired boiler makes up any differences.

"In the case of an average building, however, why not put in less electric boiler and more light in the rooms? The lamps in your rooms will give you just as much heat as if you used the same amount of electricity in a boiler and you get the extra illumination thrown in for nothing. In first cost, I believe, the lamp bulbs are cheaper heating units than electric boilers.

"Reminds me of that fellow we were working with out in Ohio. He wanted to heat his greenhouse with electricity. 'If you're going to use that much electricity,' we asked, 'Why have a greenhouse at all? Just put the plants under an opaque roof and get both light and heat electrically. It will take less electricity than the heat alone would in a glass-walled greenhouse'."

General Motors Starts Mass Production of Diesels

LAST MONTH, General Motors started mass production of diesel engines in a comp'etely new Detroit plant—capacity 50 engines per 8-hr day. These 2-cycle engines, made in 1-, 3-, 4- and 6-cyl blocks, ranging from 22 to 160 hp, will round out a complete range of diesel sizes for GM. The Cleveland Diesel Engine Division (formerly Winton) builds engines from 200 to 400 hp, while the new engine factory of the Electromotive Corp (GM subsidiary) at LaGrange, Ill., will turn out diesels of 600 to 1200 hp. Packaged complete power units (with generator) will be assembled at Cleveland plant from either Detroit or Cleveland-made diesels.

The news from Detroit has attracted the most attention, involving a new plant where none existed, a new and unusual engine design and the entry of General Motors into the small-diesel field with a mass-production technique based on automotive

GENERAL SPECIFICATIONS OF MODEL 71 SERIES DIESELS
(2-cycle, 71 cu in. in disp per cyl)

	Model 3–71	*Model 4–71*	*Model 6–71*
No. of cylinders	3	4	6
Bore and stroke, in	4¼ x 5	4¼ x 5	4¼ x 5
Maximum hp output at 1800 rpm	80	107	160
Continuous hp rating at 1200 rpm	45	60	90
Continuous hp rating BMEP	70	70	70
Compression ratio	16 :1	16 :1	16 :1
Piston speed, ft per min at 1200 rpm	1000	1000	1000
Exhaust valves per cyl	2	2	2
Exhaust valve diameter, in	1 11/16	1 11/16	1 11/16
Firing order { Clockwise (cranking) rotation	1–3–2	1–3–4–2	1–5–3–6–2–4
Firing order { Counter clockwise rotation	1–2–3	1–2–4–3	1–4–2–6–3–5
Crank angles, deg	120	90	60
No. of main bearings	4	5	7
Main bearing diameter, in	3½	3½	3½
Main bearing length, in	1⅛	1⅛	1⅛
Crankpin diameter, in	2¾	2¾	2¾
Crankpin bearing length, in	1 25/32	1 25/32	1 25/32
Clutch size, in	14	15½	17
Weight of basic engine (dry),* lb	1160	1330	1635
Fuel consumption, lb/bhp hr	0.45	0.45	0.45

* Engine weight includes: starting motor, governor, oil cooler, oil filter, and fuel filter. Generator, cooling fan, oil bath, air cleaner, air-intake elbow and engine mountings are not included in the above weights.

experience. The engines will be sold for stationary power use, as well as for marine, bus, truck, tractor and similar applications. In weight, space and cost the new units will be competitive with gasoline engines.

The 2-stroke cycle was selected for the Series 71 engine as the only way to compete with gasoline engines in weight, space and first cost.

The following comments and specifications refer exclusively to the Detroit plant and its sole product (aside from injectors for all GM diesels)—the Series 71 engine.

All engines (1-, 3-, 4-, 6-cyl) are identical, in all elements associated with the individual cylinder, including bore, stroke, piston, connecting rod, unit injector, exhaust valves, liners. All cylinders are en bloc. Each block is symmetrical. Cylinder top can be turned end for end. Exhaust and water manifolds, and practically all auxiliaries, may be shifted from one side of engine to the other, and in various combinations. By shifting two gears, engine rotation can be reversed. All sizes are exact duplicates in the end views.

These features reduce manufacturing cost and reduce the inventory of spare parts to be carried by users and distributors; also permit the engine to be adapted quickly to special requirements of the working space.

Other features of Series 71 engines: 2-cycle to reduce weight, space and cost. Scavenging air provided by 3-lobed spiral blower. Each cylinder has a separate injector unit in head, cam-shaft operated. Removable dry liners. Cylinder head removable with overhead valves as one piece. Water pump, fuel-transfer pump and governor mounted on blower and driven by it. Fuel is ordinary home furnace oil (No. 1, 2 or 3) or equivalent; lube oil ordinary SAE 20 or 30.

Crank Angles

Since each cylinder of 2-cycle engine fires each revolution, crank angles cannot be same as for 4-cycle of same number of cylinders.

In general, engine pistons set up two kinds of unbalance. "Primary" unbalance is a once-a-revolution shake caused by the up-and-down motion of the piston (assuming it keeps step with the crank). "Secondary" unbalance is the smaller, twice-a-revolution shake caused by the fact that connecting rod angularity makes the up-and-down motion of the piston somewhat different from the up-and-down motion of the crank.

The ordinary arrangement of cranks in 4-cycle engines of 4 and 6 cylinders cancels the primary unbalance and leaves the secondary to show up as vibration. The 2-cycle crank arrangement shown cancels out the secondary unbalance and leaves the primary. This primary, in turn, is then cancelled by two special parallel balancing shafts, which also serve as camshafts, operating exhaust valves and injectors. These shafts are eccentrically weighted at both ends, and geared together to run in opposite directions. At every instant the weight positions on one shaft are mirror images of the positions on the other, so that the pair of shafts produces nothing but vertical counterbalancing forces and couples.

The blower has two 3-lobed spiral meshing rotors, machined by a process resembling spiral-gear shaping. Rotors never touch in rotation, are geared together and run quietly with 8/1000-in. clearance.

Materials

Cylinder block—Alloy CI

Cylinder liners—Alloy CI, heat-treated

Pistons—Alloy CI tin-plated to fill pores

Blower casing and rotors—cast aluminum alloy

Piston rod—drop-forged chrome-molybdenum steel

Crank shaft—hardened alloy steel

Injector plunger and barrel—nitrited chrome-molybdenum steel, machined and lapped to tolerance of 50 millionths of an inch.

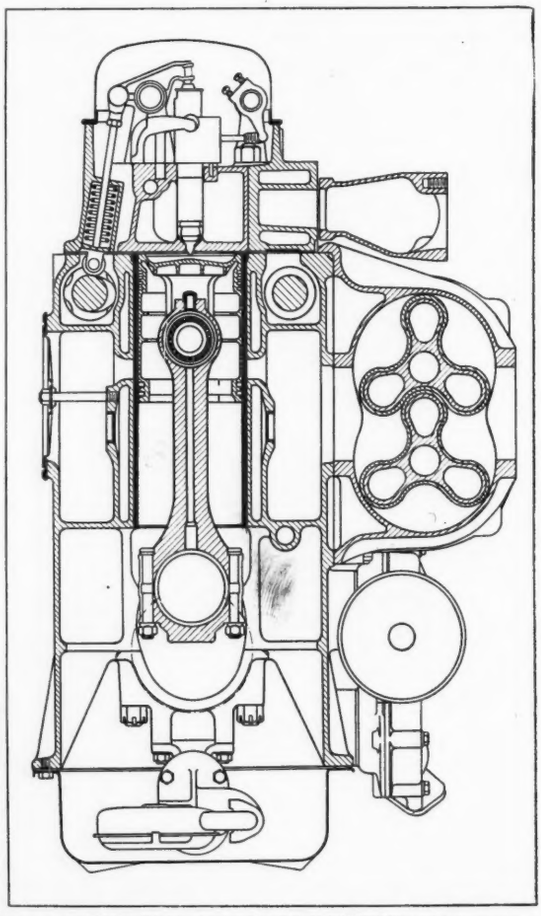


Fig. 2—Lateral cross-section of 3-cyl, 80-hp model. Note spiral-lobed scavenging blower and twin camshafts (also used as balancing shafts)

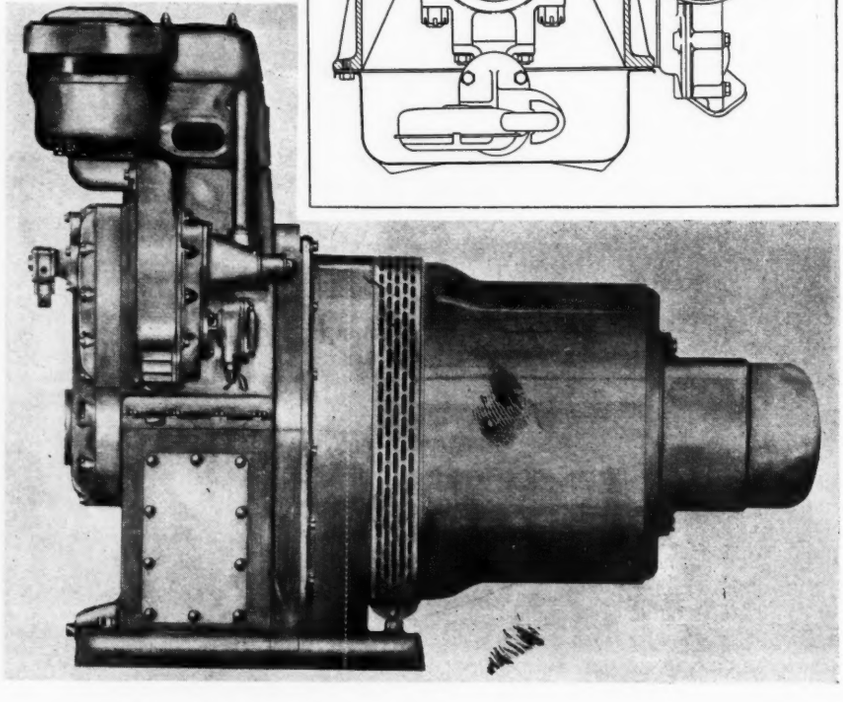
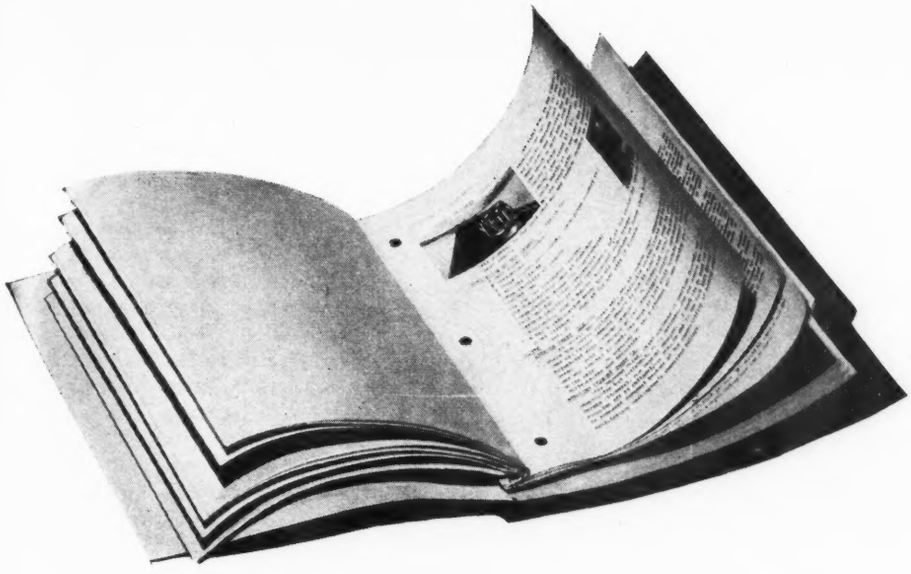


Fig. 3—All Detroit-Division diesels are 2-cycle, with 4½x5-in. cylinders, exhaust valves and unit injectors. They range from this 1-cyl, 22-hp engine (shown here fitted to generator) to 6-cyl, 160-hp unit)



Log Rolling

Dan Gutleben has ideas. They work in his plant, so he passes them on to others. Basically, the whole thing is a good plant log

BY E J TANGERMAN
Consulting Editor

THERE'S an old saw about leading a horse to water, and the difficulties in making him drink. But any farmer knows that if you let a horse go thirsty long enough, he'll drink and like it. That's exactly what Dan Gutleben, engineer at Pennsylvania Sugar Co, worked out for himself. It's worked for something over ten years, so now he's suggesting it to others.

On Being Observant

For ten years, Dan has kept a detailed log of what goes on in his plant, a combination record of what people say, what happens, how things are done, and what they cost. Dan is observant, so he notices the little things that make big differences. One copy of his daily log goes into his file, one to the plant file, and one to the plant manager—who can't afford *not* to read it because of the detailed data it gives him on happenings in his own plant. Dan tells about the millwright who lost his false teeth repeatedly—until he found that chewing gum would hold them in. Or he tells about how the men improvised an altar during a strike. That's good small talk for the manager on his daily trips through the plant.

But all this hides a hook. For Dan also tells how equipment is working, and what can be done to improve it. He gives costs, savings, losses because the thing isn't done, and so on. Eventually, the manager decides to follow the suggestion. Dan gets his improvement—but there lies the hook for Dan—the improvement must pan out as he predicted, or he is on the spot. Thus far, his record is clear.

After ten years, such a record is invaluable. Completely indexed and annotated, it provides ready access to basic data on any plant equipment, as well as running comment on its operation, necessary maintenance, and so on. It offers another tremendous possibility—that of interchange of ideas between plants—providing all keep similar records (you've seen examples in *Power* from time to time). And that's what Dan is up to now. He's sending out to particular friends (who are also chief or plant engineers) the little 3x4-in. prospectus pictured at the top of this page. In it are photographic reproductions of sample pages from his log. Every Christmas, too, he writes a lengthy letter to a friend on the Pacific Coast, including dozens of interesting excerpts from his log, then makes 50 or more blueprints of the letter and mails them to engineer friends. Talk about data! That letter has it—and is a frank bid for similar confidences from his correspondents.

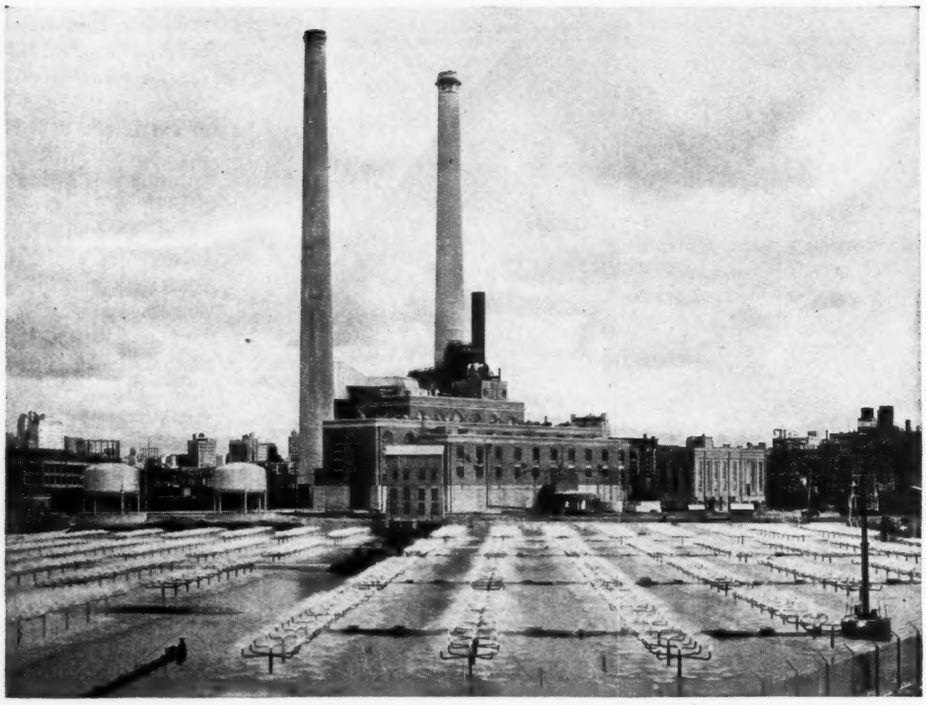
There are a half-dozen nuggets in last year's letter. One, for example, explains a slagging difficulty they were having under their boilers. They laid it on the coal. A "coal doctor" came in and explained that by treating the coal with certain chemicals, the slag-forming proclivities of the ash could be counteracted. So they spent $2500 for his stuff—it did do some good. Then the order was issued to cut the chemical out and see what happened. At this point the operators realized that executive attention was focused on the job, so they applied themselves more diligently, and found that careful control of temperatures could save the $2500. Thus, during the process of testing an antidote, we frequently discover the means of avoiding the need for the antidote.

Further, Dan proves out George Edwards' slogan of "Take time to be brief"—by explaining how it took them two years to discover a little baffle change in their boilers that cost only $250 but saved thousands of dollars worth of burned tubes. And again he tells about the two fellows who rushed into a pipe-supply house one Sunday afternoon, insisting they had to have a particular length of pipe to fix a boiler, or the health of some thousands of kids would be imperiled. Dan started to ask questions, and found they represented "The General Institute of Child Hygiene," whose main job was to launder 200,000 diapers daily—5 million a month—for households and hospitals.

And finally about the local fraternal organization that installed a charity peanut vendor in the plant. It chanced that a valve on the CO_2 equipment uses disks almost exactly the size and weight of a penny. After a month, the collector came around, to get a handful of valve disks—and four cents. Says Dan, cryptically, "Somebody was careless with his money!"

Future Generations

It is hard to estimate the value of a log like Dan's. Future generations of engineers will bless him for it even more than those others who now find it interesting, inspirational, and complete, as well as downright useful. Perhaps the best way to express it is in Dan's own words: "It is a meritorious sort of activity. The implements of the 'commentator' are a good camera and a nimble pen. The successor along your path will appreciate the record upon which he may build, and he will say kindly things about you. For the balance of the compensation, you will have to trust to Saint Peter."



Spray ponds like this are kept free of slime by proper application of chlorine, chlorine compounds, or chloramines

Taking the Bugs Out

Some practical slants on new ways to keep slime and algae off condenser tubes by chlorinating

By S A TUCKER
Associate Editor

REPORTS on chlorination begin by discussing the life and habits of bacillariacae or the complex mechanics of the "OCl" radical. The simple process of poisoning microscopic bugs is the development of the chemist and the biologist, but their shop talk too often obscures their valuable contribution to plant operation by language unfamiliar to power men. Brushing away this fog, the up-to-date facts of real use to power engineers can be presented quite simply and briefly.

New methods have been developed for chemical treatment of circulating-water supplies. More important, new ideas about time between treatments and ammonia-chlorine mixtures allow more freedom of choice as to how to tackle a slime problem. The whole story would fill a book and make poor reading, but the simple report of what some plants are doing, even though incomplete, may be useful to those now treating circulating water as well as others not so familiar with the process.

First, it has been established beyond question that, in certain waters at least, condenser tubes and other heat-transfer surfaces can be kept slime free with treatments as infrequent as once a day. Three years ago this information was not generally available. Two years of experimenting have proved it successful.

Second, a combination of chlorine and ammonia, in proper proportions, does not lose its effectiveness as fast as chlorine alone. In very polluted waters and for closed circulating systems, these two chemicals, combined to form chloramines, have a very real advantage over previously accepted standard treatments.

Third, where a slime problem exists, the effect of chlorine treatment can be established experimentally and possible economies made in fact (not calculated) before a large investment is made in permanent equipment. Trial treatment requires practically no expense for equipment and involves no hazard from chlorine gas.

These three ideas are backed up by actual experience of plants whose case histories can be checked in detail. One central station is treating a number of condensers for a 30-minute period once every 24 hours. A chlorinator supplies solution made from chlorine gas purchased as liquid in 150-lb cylinders. Treatment is applied to the suction pipe of each circulating pump in turn. About 3 ppm of chlorine is introduced, enough to maintain a residual over one ppm of available chlorine at the tail-pipe connection.

Another plant gets satisfactory results by introducing a solution each night into the condenser water space

and letting the solution soak in for a period of an hour or longer. The solution is made from sodium hypochlorite delivered as a liquid in tank trucks or rubber-lined barrels. The quantity is adjusted to give a definite residual of available chlorine at the end of the soaking period; the amount introduced varies from 10 to 50 parts of chlorine per million of water.

Another development of importance has previously been reported (*Power*, August 1936) in an instance where the usual chlorinating procedure failed to produce satisfactory results due to extreme pollution of the water supply. In this case, formation of chloramines by the reaction of ammonia and chlorine in very dilute water solution had prevented or delayed the waste of active chlorine on the organic matter of the water supply so that an effective residual was maintained throughout the condenser. The treatment period is about thirty minutes once a day and requires about four parts of available chlorine per million parts of water plus the proper amount of ammonia to form chloramines. Chlorine is purchased as bleaching powder (calcium hypochlorite), and the ammonia as ammonium sulphate. They must be fed separately and the ratio of bleaching powder to ammonium sulphate is five to one.

Other Variations

A fourth method of treatment is used with success in one plant, but involves an admitted risk of corrosion. The condenser is taken out of service and the water spaces evacuated to a partial vacuum by a steam-jet ejector. Then pure chlorine gas is admitted in an amount considerably less than that calculated necessary to fill the space even at the reduced pressure. The gas is permitted to remain only a few minutes and is then drawn out by the ejector and vented to the tunnel where it passes away harmlessly dissolved in the water.

These four methods indicate that there is considerable variation in period of treatment, time between applications and sources of chlorine. In addition to these, there are a great many plants using the accepted standard treatment of three to five minutes during periods of from one to three hours. Practically all the latter plants purchase chlorine in liquid form in containers and feed chlorine solution under control of a program clock. The more recent of these installations feed solution directly to the tunnel or pump suctions; older ones store the solution in limestone tower for use as needed.

Comparison of alternate systems can be made from several angles. The most important of these is duration of treatment and length of period between applications. In this respect, practice is sharply divided into two classes, either short-time treatments every hour or two, or longer treatment once each day or even less frequently. The former requires automatic-timing equipment and a relatively permanent type of installation involving high initial cost. The latter can be manual, requires only equipment of the kind that can be found around any power plant and is well suited to experimenting with dose and time variations.

Once-a-Day

While the once-a-day treatment has been found successful in some plants, there is not enough experience to assure its effectiveness under all conditions. Where applicable, however, a considerable reduction in quantity of chemical is obtained, treatment period being only 1/48 of the total time instead of about 1/12 to 1/24 as usually applied in program-controlled systems. No direct comparison is available of quantity of chlorine required per gal. of water, but where now in use, quantities for daily treatments are not greater than would be expected with hourly application.

The second basis of comparison is in the source from which the chlorine is obtained and the degree of hazard involved. Chlorine is cheapest as a liquid in tank cars or carloads of ton containers. Slightly more expensive are 150-lb cylinders. While the safe handling of chlorine can be assured in all normal circumstances, some investment is inevitably required for safety and the rate at which chlorine can be taken from the cylinders is limited. This latter characteristic requires that a number of cylinders or containers be stored. On the other hand, bleach powder is commonly shipped in sheet-iron drums and represents no hazard from any viewpoint. The amount and rate of use can be varied at will without limitation. This is a distinct advantage for trial installation. Bleach powder contains about 35% chlorine. A high-test product is also on the market containing about 70% chlorine which leaves no residue in the mixing tank.

A third aspect also has to do with initial cost. A chlorinator is a refined instrument capable of accurate and nearly automatic operation. Together with rubber-lined solution piping, it represents a considerable item of expense. Experimenting can be done with bleach powder by mixing solution in the drums in which the powder is shipped. The solution can then be fed into the system through ordinary rubber hose.

If the condenser can be removed from service for soaking, or if the cooling-water system is closed, a very cheap and effective daily treatment can be worked out, calculating amount of chlorine required from the entire water content of the circuit.

Chemical treatment with chlorine or chloramines is effective only insofar as it poisons living organisms. Slime, composed of algae which are living cells, may have entrained a large percentage of inorganic dirt. Attempts at removing thick slime films by relatively small chlorine doses have been largely unsuccessful. Once the thick film of dirt and dead algae have been removed by mechanical or other means, prevention of film reformation is practically always possible.

Thus far, chlorine either by itself or as chloramines is the only practical chemical effective in small concentrations against the types of algae found in condensers. Where the quantity of water is small, and particularly for closed circuits, at least two proprietary preparations are on the market, but these are not applicable to large units.

Chlorine or compounds of chlorine are corrosive to metals in moderately strong solution. Therefore it is usual practice to dissolve the gas or powder forms in water to form a solution which can then be introduced into the circulating water. This procedure avoids gas pockets or local concentrations which might lead to corrosion.

Time Factor

The time during which chlorine remains effective in dilute solution must be taken into account. In the circulating system, some of the chlorine is used up on the organic matter in the water from sewage or other pollution. As far as the algae living on the condenser-tube walls are concerned, this amount is wasted. Only the amount of effective chlorine remaining as the water sweeps past the tube surfaces is useful in keeping them clean. Chlorine solution is therefore introduced as near the circulating-pump suction as possible and still assure thorough mixing.

Rate of loss of chlorine effectiveness in polluted waters is quite rapid. When three ppm of chlorine are added to reasonably good circulating water, only one ppm or less remains after a period of one minute. However, when chloramines are formed, by addition of ammonia, the rate of action is slowed down and a greater part of the initial chemical remains after a period of time. Chloramines are, therefore, more effective than chlorine if the point of application must be far removed from the heat-transfer surfaces or if the system is a closed one and the entire circuit is to be kept free of algae.

More Steam From Wood Waste

Two-stage furnace under Stirling boiler increases steaming capacity and eliminates smoke nuisance at plant of Vancouver Plywood and Veneer Co

By G C DESLER
Chief Engineer

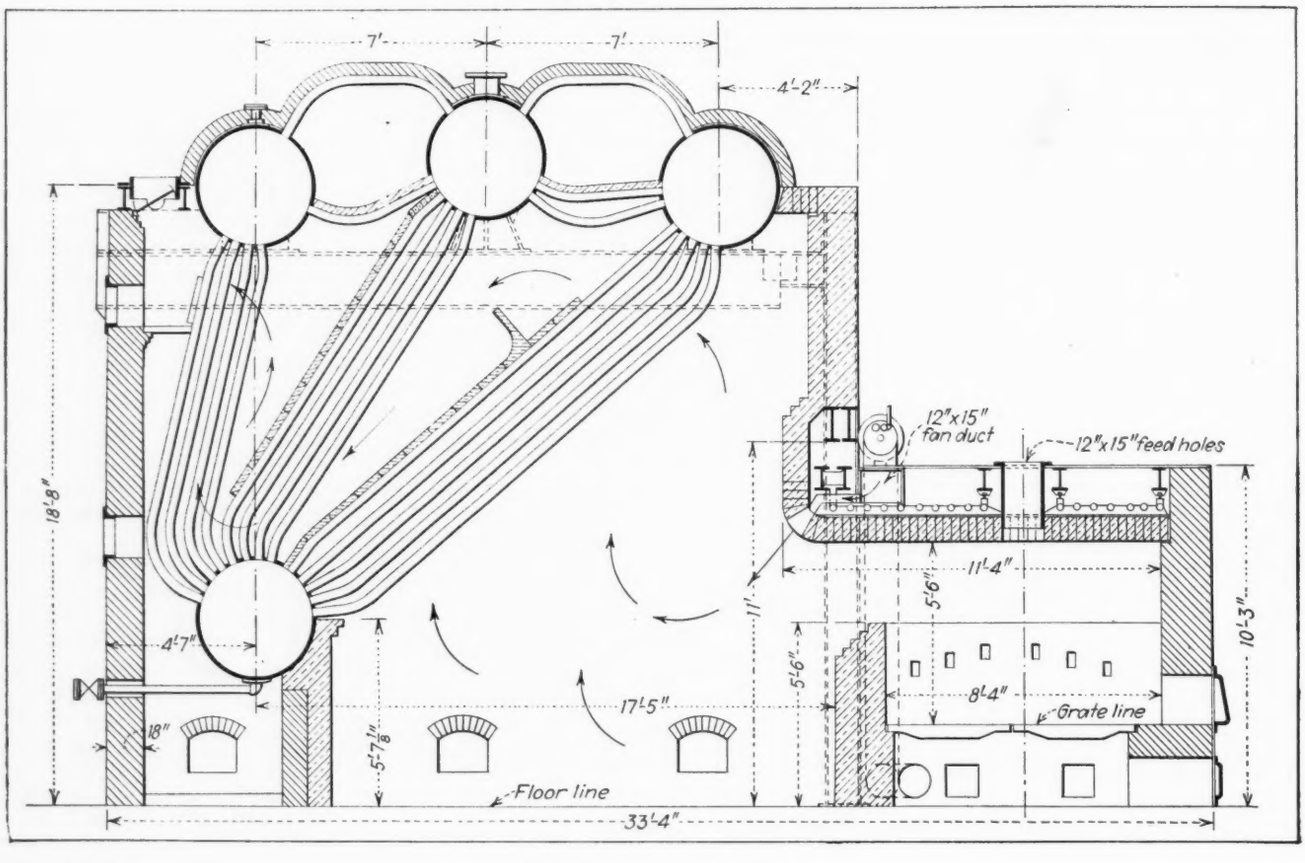
NEED for 100% increase in steaming capacity and for elimination of a smoke nuisance started the Vancouver Plywood and Veneer Co, Vancouver, Wash., on an investigation of improved methods for burning waste fuel, and finally led to the adoption of a semi-producer-gas furnace which has met all requirements.

Late in 1936, the Company started making plans to improve the plant and enlarge capacity. A survey of steam requirements indicated that 52,000 lb per hr would be necessary to supply the 750-kw condensing turbine, two engines, pumps, heating system, and dryers. To produce this steam there were two boilers: one Scott (type A) of 3000 sq ft heating surface and one Stirling (old type) of 4480 sq ft. Several checks showed that maximum production for these boilers on the fuel available did not at any time exceed 25,000 lb per hr.

During this period, a malt manufacturing plant was completed on an adjoining property, located in such a position that smoke and cinders from the veneer-plant stacks were carried directly over the new premises. This led to notification that the nuisance would have to be stopped or it would be necessary to pay for damaged malt stock. Thus, it was necessary to eliminate smoke and cinders while adding steaming capacity.

Fuel burned in this plant is sander dust, hogged veneer-lumber waste and ground bark from the barking machine. The average moisture content of the mixed fuel is 44%. Some idea of the fuel characteristics can be gotten from a brief description of its production. The barking machine has a high-speed rotary cutting head moving longitudinally on a shaft as the log rotates in lathe chucks. Water is run over the cutter head to reduce bark dust. The resulting fuel is fine, wet, and contains a large percentage

Fig. 1—Longitudinal section through boiler and new furnace, with Dutch-oven extension, and primary and secondary air supply



of sap from the outer surface of the logs. With this method of peeling, the bark contains an accumulation of sand and dirt, and this mixture with sander dust makes a slag that is difficult to remove. With the old system of firing, the boilers were taken out of service for 18 to 20 hours at 30-day intervals for grate-bar replacements.

The hunt for an improved method of burning this waste fuel was begun by soliciting information and proposals from all engineering companies in the territory. Recommendations received included raising the boiler 8 ft above the present setting, increasing the height of the stacks by 40 ft, changing all the steam mains, and raising the boiler-room roof to accommodate the new high settings.

One of the proposals was not immediately considered, since it was a departure from ordinary furnace practice. But after several months of comparing costs and anticipated results, it was decided to incorporate this furnace with the Stirling boiler.

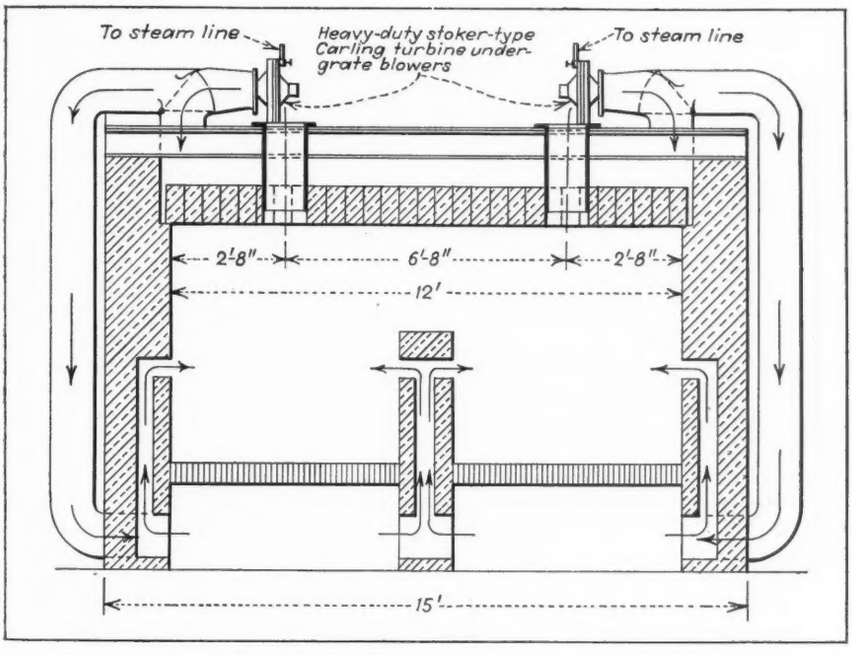


Fig. 2—Section at AA, showing method of introducing air through sidewalls and combustion pier, also arrangement of fans and ducts

Two-Stage Combustion

Employing 2-stage combustion with fan-supplied primary and secondary air, this furnace changes fuel into gas in the primary chamber. The gas is burned with secondary air in the combustion chamber back of a bridge-wall. Figs. 1 and 2 show how additional combustion space was obtained without raising the boiler. The front wall was set out from the front drum and a Dutch oven extended from that point.

Both primary and secondary air are supplied by steam-turbine-driven fans mounted on the firing deck with control valves easily accessible to the operator. Ducts for admission of primary air to the fuel bed pass through the sidewalls and the center pier, so that air is driven horizontally into the fuel bed instead of vertically through the grate bars. Experience indicates that, with this arrangement, fuel is not lifted and carried over into the combustion chamber. After five months operation, there is no cinder accumulation.

Air-cooled, ventilated walls are used throughout. No bad crack or breaking away of brickwork has been noticed and the temperature of sidewalls or furnace front has not been unduly high. With the old furnaces, refractories failed quickly from slagging and flame abrasion when sander dust was excessive. In the new furnace, with its air-cooled sidewalls and combustion piers, plus regulated draft, damage to brickwork has been reduced to a minimum. Frequent replacement of grate bars due to the slagging effect of sand and dirt from the bark, and sander dust, has also been eliminated. Grate cleaning is simple and easy, and only necessary once in 24 hours.

Formerly, trouble was encountered burning ground bark alone, although it burned fairly well when mixed with sander dust and hog. Since surplus bark from the day's run goes into the fuel house, there were times on the night shift when ground bark was the only fuel available. This was a serious problem, but the new furnace arrangement has solved it; the entire night load can be carried on one boiler, burning ground bark without difficulty.

The success of the installation in enlarging steaming capacity and eliminating the smoke and cinder nuisance can be judged by results of tests recently made. An evaporation of 35,650 lb per hr, 257% rating, has been attained without smoke or cinder. Stack temperatures range from 540 to 620 F. The highest temperature recorded in the combustion chamber was 2200 F and the lowest 1700 F (in front of the mud-drum wall). A temperature of 1750 F was measured between the front wall and the boiler tubes. On another test, after facilities for draft readings and flue-gas analysis had been provided, a CO_2 range of 14-16.4% was obtained. Draft in the second pass was 0.5 in., and in the stack 0.8 in. Operation during this latter test was at 200% rating. As fuel in this plant has no commercial value, no effort has been made to measure efficiency.

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Russian Boilers

RUSSIA'S trend of development in steam generation is decidedly towards the once-through boiler, reports *The Steam Engineer* (England), September, 1937. Russia's 1937 program provided for 26 once-through boilers, generating a total of 1,300,000 kw. Of this number, 19 units, generating 1,000,000 kw, will work on a pressure of 2000 lb per sq in.

From the standpoint of the Russian boiler industry, the principal advantage of the once-through design is the absence of heavy costly drums. Moreover, forced circulation permits further economy in metal by removing the many lightly loaded tubes of a natural-circulation system, and the positive character of forced circulation leads to a great increase in rate of evaporation per sq ft of heating surface.

At the present time there are in Russia two Loeffler boilers with a capacity of 330,000 lb per hr each at 1850-lb pressure, and also two once-through boilers. The experimental Ramzin boiler was built in 1931 and its commercial edition, started up in 1933, is rated 440,000 lb per hr at 2000 lb per sq in. Although both LaMont and Velox boilers are being investigated, present development is planned around the once-through design of Prof L K Ramzin, whose boiler was exhaustively tested for a 3-year period.

Hydro Plant Goes Modern

Two 665-hp propeller turbines replace old geared water-wheel plants, improving efficiency and more than doubling useful power output

BY GEORGE WILLOCK
Engineer, Trollhattan, Sweden

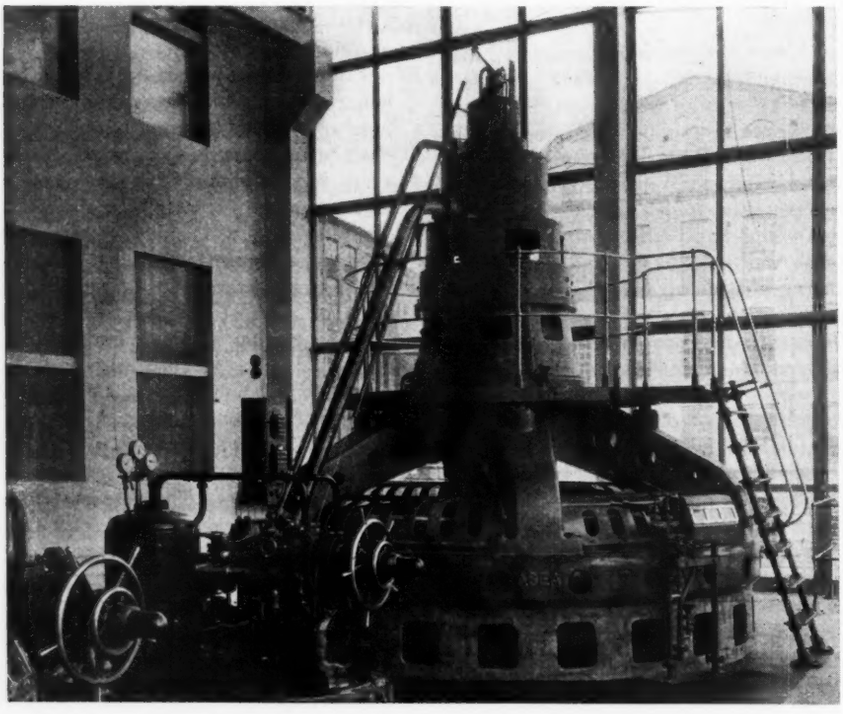
IN SWEDEN, where hydro plants are a common source of industrial power, modernization is achieving greater output and higher efficiency, and reducing operating costs. What has been done at Norrköping by Norrköpings Bomullsväveri A B, one of Sweden's largest linen manufacturers, has tuned up this plant with today's practice.

Before 1935, power was generated in two hydro plants. One, at the upper end of the mill, had a single 375-hp, horizontal-shaft, double-francis-runner unit operating at 8-ft head. At the lower end of the mill, a 440-hp plant had three vertical-shaft francis wheels operating at about the same head. The old slow-speed turbines, geared to their loads, were noisy and lost power. Water available at the plant is variable and on occasion could not be used efficiently.

The new plant, built just outside the downstream wall of the mill, contains two 665-hp propeller turbines with adjustable blades. Former difficulties have been overcome by these new turbines, which operate at much higher speeds than corresponding francis units and permit direct connection to generators. Adjustibility of blade angle has resulted in more efficient use of water over a wide range of head and flow.

Space for the intake canal that runs under the mill is restricted, so that racks are placed at an angle to increase their length and reduce losses through them. Bars are skewed slightly to the rack face in order to make bar sides conform to the angles of flow. Because of the unsymetrical form of the inlet, flow angle varies across the rack face, but bars have been placed parallel to flow at all locations. Tests were made on models at the Royal Technical College, Stockholm, to determine correct angle of the rack bars. Welded construction made possible placing the bars at any desired angle.

To reduce excavation costs and also because of low head, turbines were set in syphons with runners above headwater level, Fig. 1. This is the first medium-size plant of this type in Sweden.



One of two 900-kva generators directly connected to 665-hp propeller turbines at 8-ft head

Turbine Intake

The turbine intake was extended under the mill to obtain a syphon-shaped inlet that would prevent air suction through the runner. As the turbine runner is above headwater, draft-tube stop logs are not required for unwatering during inspection and repairs.

Each turbine, vertical-shaft design with governor-regulated runner blades, has a normal rating of 665 hp at 125 rpm under 8-ft head. Each runner has four blades that are given an angle corresponding to head and flow by a governor-operated servomotor. As there was no danger of pitting from cavitation, blades are cast steel instead of chrome-nickel steel.

Wheel gates, crown plate and lower guide ring are cast iron. Gate spindles project through crown-plate stuffing boxes, where they are connected through levers and breaking links to the operating ring.

To facilitate dismantling, turbine shafts are made in two lengths of forged steel connected by solid forged flanges. On the turbine, the shaft runs in a grease-lubricated white-metal-lined journal bearing, supported on the crown plate. A water-sealed labyrinth box, at the point where the shaft projects through the crown plate, Fig. 2, keeps air from being drawn into the wheel pit. This is necessary because of absence of pressure under the crown plate (the turbine is above high-water level).

Automatic oil-pressure governors for each turbine consist of a servomotor controlling the gates, oil-pump governor head, regulating valves and compensating gear, pressure receiver with reservoir, and the servomotor controlling the runner blades.

The governor head is a combined spring and weight mechanism. A gear oil pump beneath the servomotor is belt-driven along with the governor head through a bevel gear from the turbine shaft. A reserve motor-driven pump starts automatically if oil supply from the main pump fails, or if the main pump cannot maintain pressure. The servomotor controlling the runner blades operates on governor-pressure oil and is on top of the alternator. Advantages of this arrangement over placing the servomotor inside the runner include: more space inside the runner hub for levers, permitting a heavier design that eliminates risk of breakage; no oil under high pressure in the hub, thus eliminating all risk of leakage; and a servomotor easily accessible to inspection.

Servomotor

The runner-blade-servomotor piston is connected to a crosspiece inside the runner hub by a rod passing through the hollow alternator and turbine shafts. Links transfer piston motion to levers keyed to stub shafts of the runner blades. The servomotor, in addition to adjusting blade position according to load, also causes the blades to take automatically the position required for starting when the turbine is shut down.

On starting up, a 370-cfm motor-driven rotary air pump evacuates the turbine flumes. The pump connects flumes by piping and evacuates either in about 10 min. When a unit is shut down for a short time, it is not generally necessary to evacuate the flume before starting, as considerable time must elapse before water level falls. Safety devices cause the governor to shut down the turbine in case of runaway, governor-belt breakage, failing oil pressure, heating of bearings and electrical-system faults.

Each alternator, rated 900 kva, 50 cycles, 400 volts at 0.60% power factor, has a direct-coupled 22-kw, 230-volt exciter. Weight of the rotating parts of turbine and alternator and unbalanced water pressure is carried by the alternator thrust bearing. Immediately above the thrust bearing is the exciter and above this, the servomotor for controlling the runner blades.

Brakes comprising three oil-pressure jacks, act on the lower edges of alternator rotors. The brake, primarily a stopping device, will also lift the rotor to permit removing thrust-bearing pads when this is required.

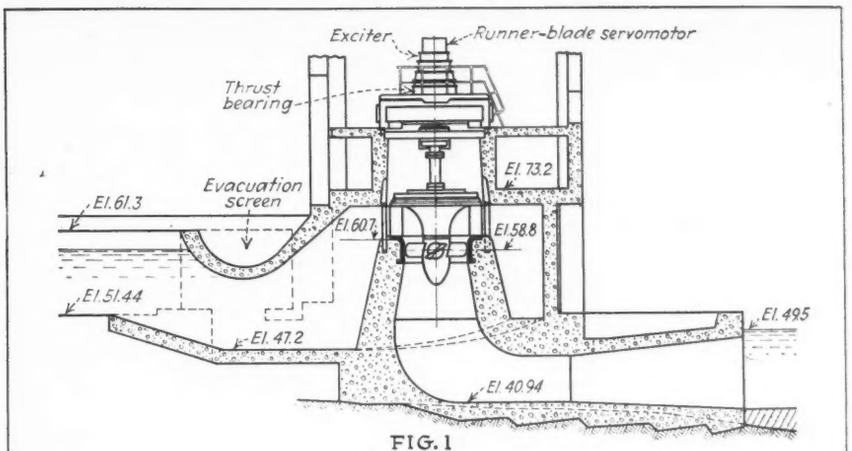


FIG. 1

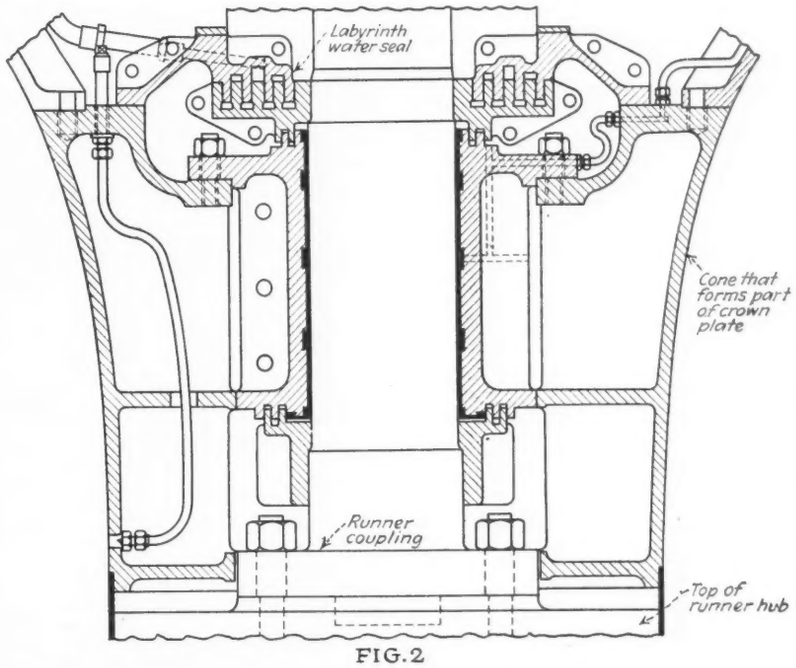


FIG. 2

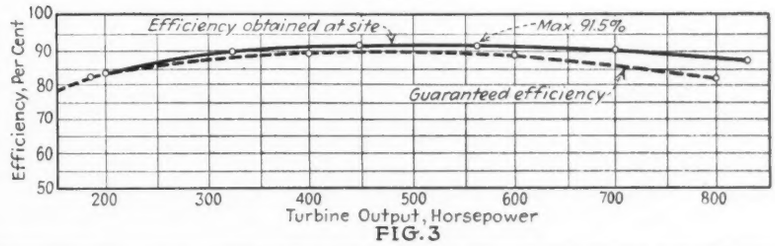


FIG. 3

Fig. 1—Because of low head, turbine runners are above water level in a syphon setting. Fig. 2—Labyrinth water seal, where the runner shaft extends through the crown plate, keeps air out of the syphon setting. Fig. 3—Guaranteed and test efficiency curves of the 665-hp turbines

Turbine tests were made by Prof Hjalmar O Dahl, of the Royal Technical College, Stockholm. Water was measured by seven current meters in the inlet tunnel. Maximum output obtained was 830 hp, compared with a guaranteed output of 665. The curves, Fig. 3, show an efficiency of 90% and higher obtained in the range of 300 to 750 hp. At all loads, test efficiency exceeded guarantee.

The turbines, governors and evacuating equipment were supplied by Nydqvist & Holm A.B. (NOHAB), Trollhättan; alternators and other electrical equipment by Allmänna Svenska Elektriska Aktiebolaget (ASEA), Västeras.

The man who has not anything to boast of but his illustrious ancestors is like a potato—the only good belonging to him is underground.—Sir Thomas Overbury.

Tailored Pipe Joints

Forming field-welded ell and tee connections is easy and quick if you know these three methods for laying out the cutting line

By E W P SMITH
Consulting Engineer, Lincoln Electric Co

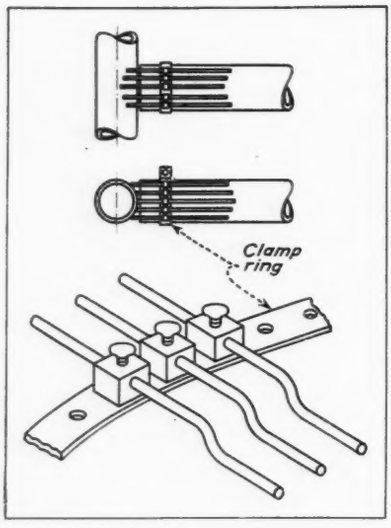


Fig. 1—Light adjustable rods on a flexible clamp ring make a simple fixture

FIELD LAYOUT of a piping system must be quick, simple, accurate, and inexpensive. There are three methods: (1) use of a fixture, (2) cut templates to accurate dimensions, (3) lay out the intersection on a pipe directly from curves or data.

Note that on all drawings, and throughout this entire discussion, the actual intersecting line on the external surface of the pipe is the line given. If the joint is beveled, the intersection line will be in the center of the bevel and when the pipe is being cut, the operator must take into account the kind of scarf and make

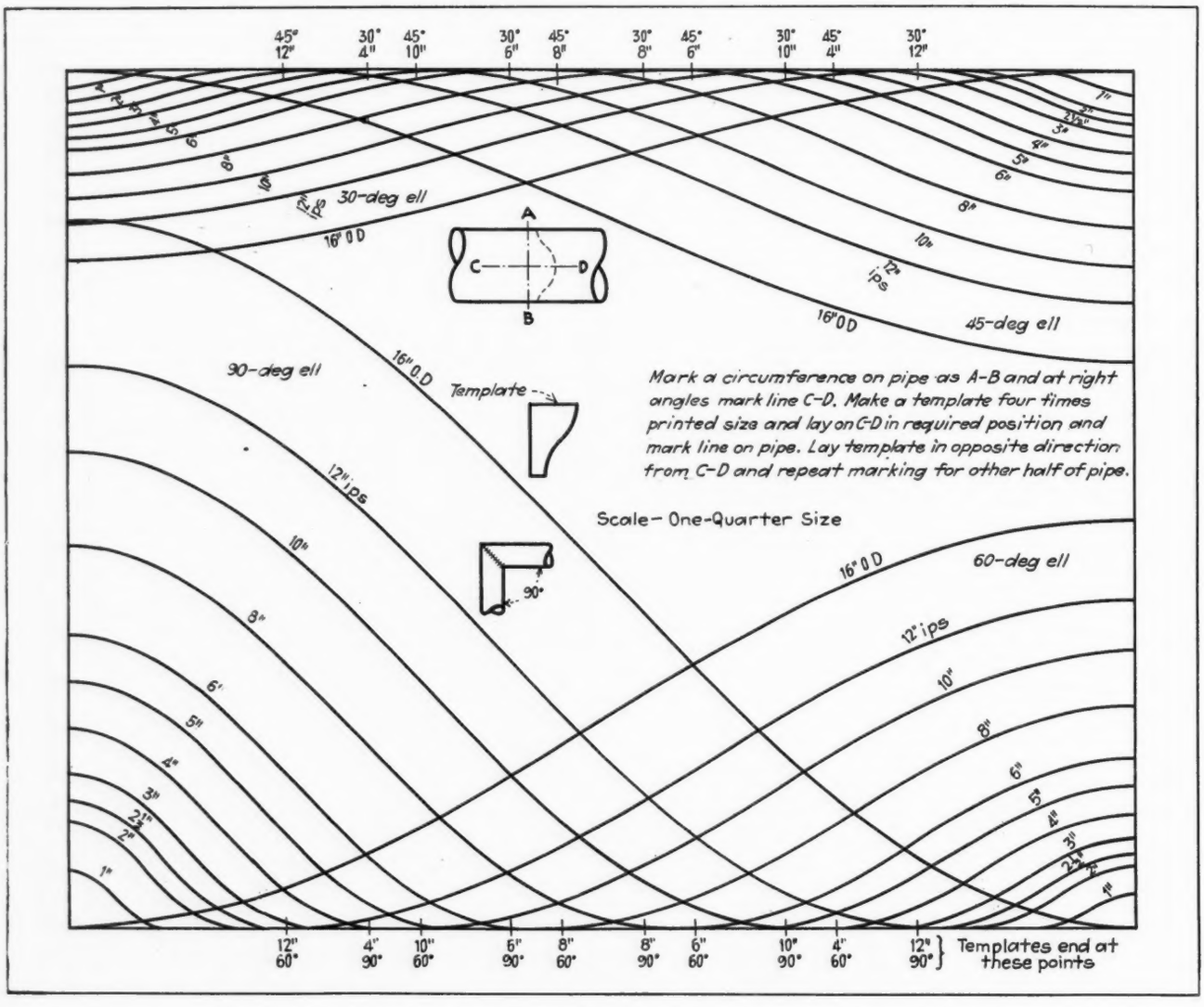


Fig. 2—Templates give an exact cutting line for ells of 90, 60, 45 and 30 deg

due allowance. Where it is not necessary to scarf, the pipe is cut directly on the intersecting line marked on the pipe.

The first method, exceedingly simple and applicable in practically all cases, involves the construction of a suitable fixture, Fig. 1. A flexible strap of rather thin material, long enough to encircle the pipe, is fitted with clamps at both ends. These hold the strap firmly to the pipe, but permit movement or removal when loosened. To this strap a number of suitably spaced smaller clamps are welded. A sufficient number of clamps should be used to enable a definite smooth curve to be drawn through the determined points. These small clamps can be square pieces of metal fitted with setscrews. Rods are passed through holes parallel to the pipe's axis. Setscrews lock the rods in any desired position or allow them to be moved in or out.

In laying out a connection, the strap is clamped around one pipe so that the ends of the movable rods in the clamp may touch the other pipe. The two pipes are then held in the desired relative position and the rods are moved until the end of each touches the other pipe. Rods are clamped in position by means of the setscrews and the curve formed by the rod ends simulates the intersection. The strap holding the assembly to the pipe is then loosened and the assembly moved back until the end of the farthest rod is just flush with the end of the pipe. The line to follow in cutting is indicated by marking the pipe at the end of each rod. This done, the clamp is removed, the curve completed, and the pipe cut as indicated. For the other pipe, connect the points marked by the rod ends in the same way.

In some cases, this method may call for a template. To make this, the strap is laid out flat on suitable material and the template drawn. This fixture permits laying out special connections for practically any size pipe. A single fixture can be used, or several can be joined together to provide the necessary length to encircle the pipe. It is advisable to have the fixture in several sections to fit various pipe sizes. However, where a single size of pipe is being used for many connections or varied intersections, a single fixture affords an easy and practical means of laying out the connection, produces a fairly accurate intersection for practically any type of pipe joint, and is not expensive.

The second method, using templates, gives the operator an exact curve that can be placed around the pipe circumference. Fig. 2 combines various templates for different size pipe for 90-, 60-, 45- and 30 deg-ells. Pipe sizes shown are nominal up to 12 in.; 16-in. pipe is outside diameter. A circumference is drawn on the pipe at a suitable distance from the point of intersection. A duplicate of the proper curve is taken from Fig. 2, depending upon the pipe size and angle desired and a template is made four times printed size. This template is placed around the pipe in the proper position on the line *CD* at a right angle to the circumference. The tem-

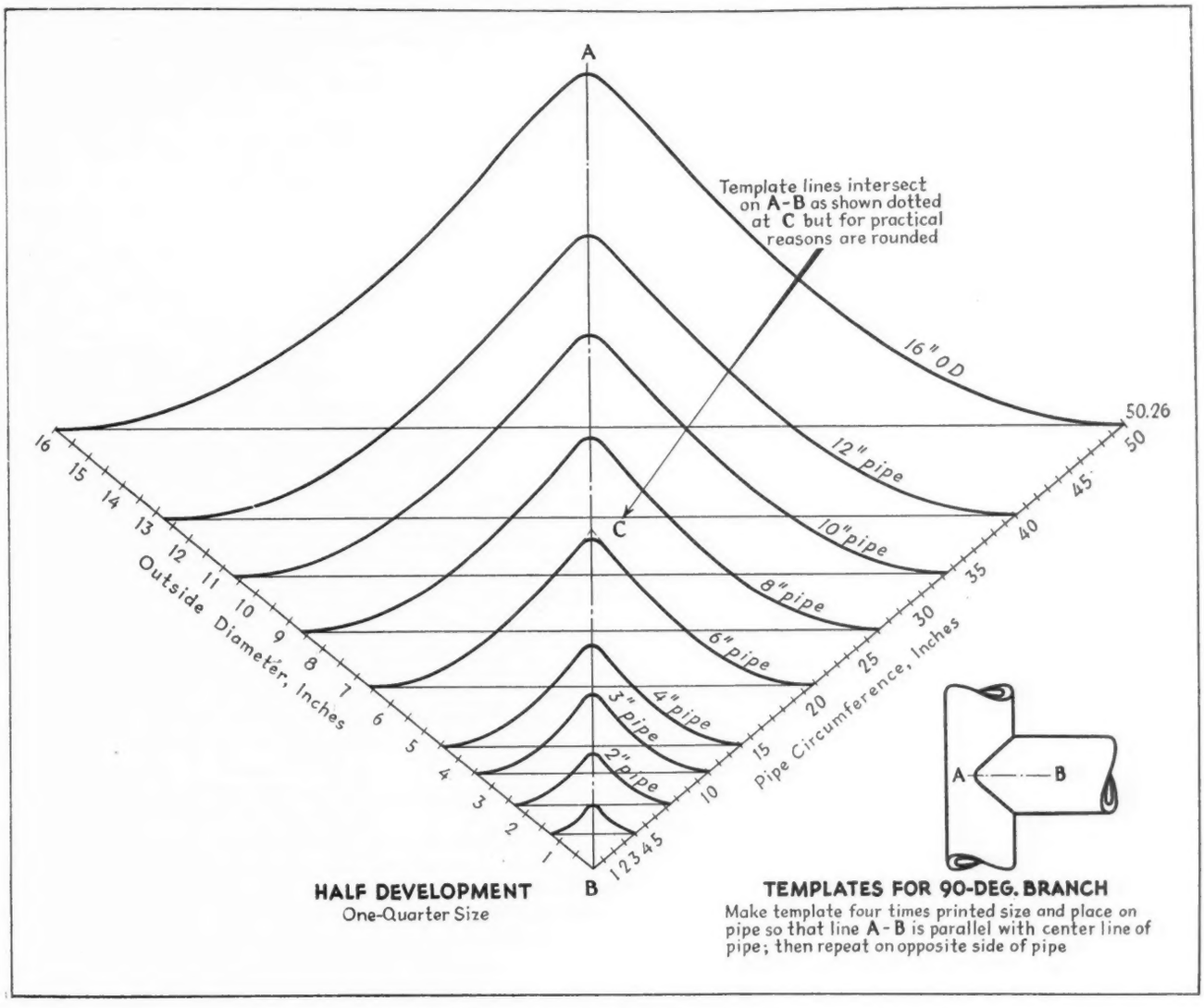


Fig. 3—Quarter-scale templates for the through run of a 1-to-1 tee

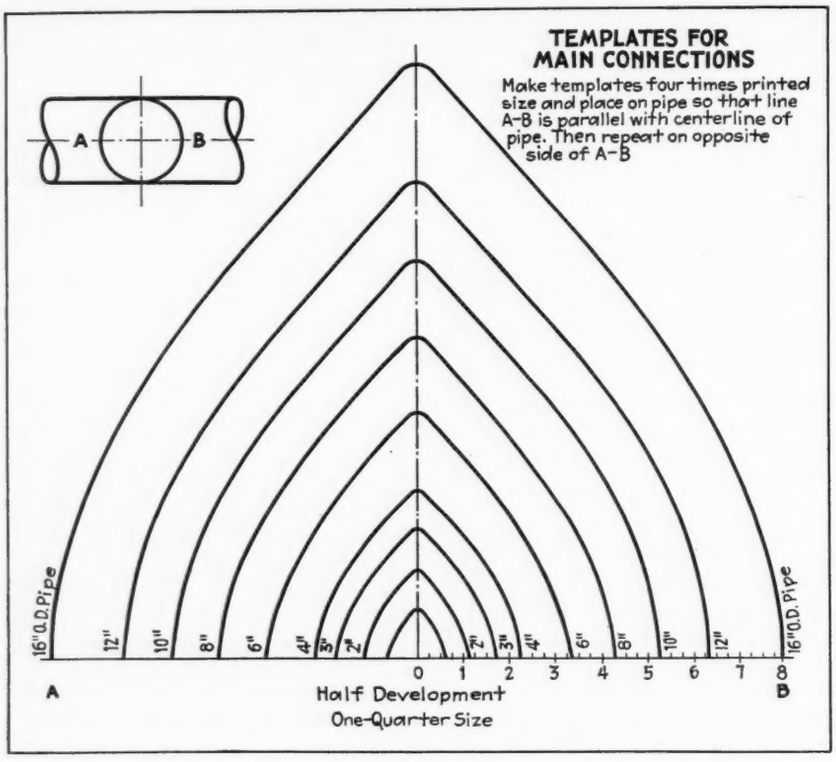


Fig. 4—Quarter-scale templates for branch connection of a 1-to-1 tee

plate covers one-half of the intersection circumference, and any variation in pipe size is taken at two opposite points on the diameter of the pipe where the curve is flat.

Fig. 3 is exactly one-quarter size and full-scale templates can be made by increasing all dimensions in four-to-one proportions. For sizes other than those given, a curve may be interpolated between any two curves in the figure. The templates may be used on any pipe regardless of thickness, as the data are given for the outside circumference. The same method is used for tees, templates for which are shown in Figs. 3 and 4.

The third method, laying out joints by means of special curves, has many advantages, particularly where special joints are being made in the field. It is faster than the template form and the only equipment needed is a string and piece of chalk, with perhaps a ruler or scale. It is, of course, necessary to have the master drawing, Fig. 5, which serves for 90-, 60-, 45- and 30-deg ells for any size of pipe. The general method of application is to place the string around the pipe and then, by doubling, to divide the

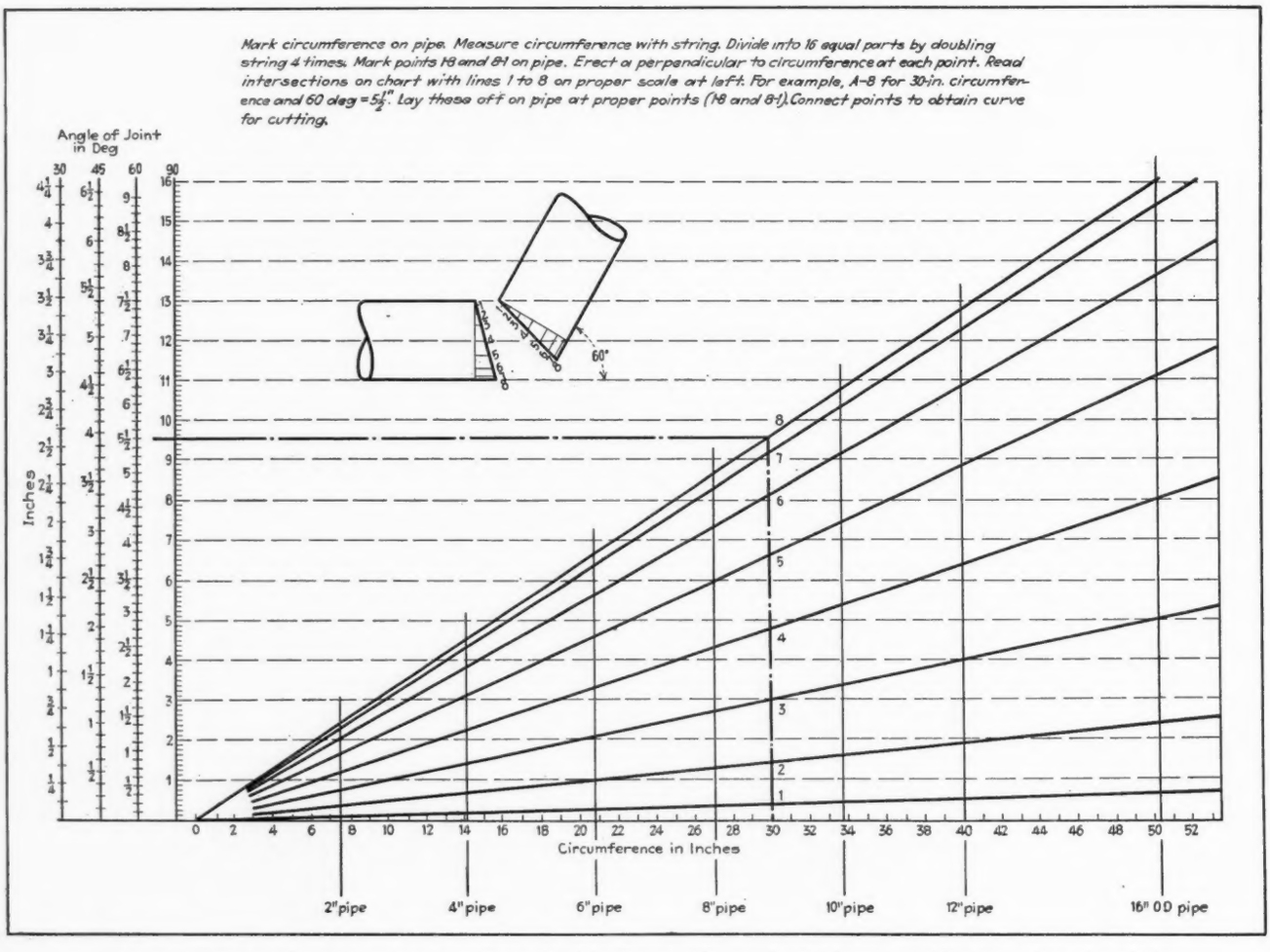

Mark circumference on pipe. Measure circumference with string. Divide into 16 equal parts by doubling string 4 times. Mark points 1-8 and 8-1 on pipe. Erect a perpendicular to circumference at each point. Read intersections on chart with lines 1 to 8 on proper scale at left. For example, A-B for 30-in. circumference and 60 deg = 5¼". Lay these off on pipe at proper points (1-8 and 8-1). Connect points to obtain curve for cutting.
Angle of Joint in Deg
30 45 60 90
Inches
60°
1 2 3 4 5 6 7 8
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52
Circumference in Inches
2" pipe
4" pipe
6" pipe
8" pipe
10" pipe
12" pipe
16" OD pipe

Fig. 5—With a piece of string, a ruler and this chart, ells can be laid out rapidly by using the eight measurements shown

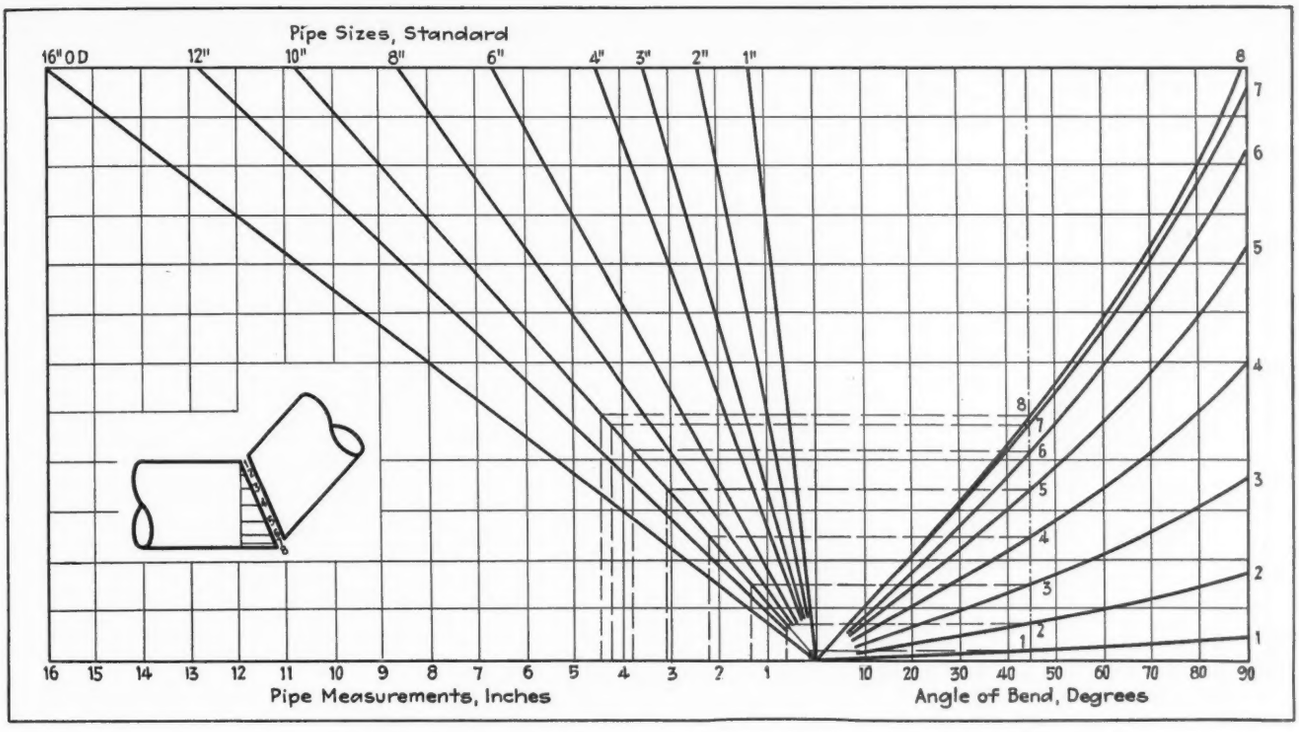


Fig. 6—Chart for ell connections at any angle permit convenient offsets.

string into halves, quarters, and eighths etc, obtaining sixteen equal points of division around the circumference. Suppose, for example, that an operator wishes to make a 60-deg ell on a pipe and that he does not know definitely the pipe size. The first step is to find the circumference of the pipe by wrapping a string around it. During this operation, he encircles the pipe with a chalk line at the proper distance from the end. The circumference is then divided into two equal sections by doubling the string and this process is repeated until sixteen parts have been obtained and marked.

Measurement of the string (circumference of pipe) in inches indicates a point on the lower scale of Fig. 5 for placing a ruler at right angles to the lower border of the drawing. This line intersects eight diagonal lines on the graph. Then the distance to the top line, that is to intersection *8*, is marked off on paper or measured by string or ruler and carried over to the column marked "60-deg ell," which in the example reads 5.5 in. This length is then laid off by the rule at one of the 16 points in a direction perpendicular to the circumference. The same procedure is then carried out for points *7, 6, 5, 4, 3, 2* and *1*, these being laid out in order around one-half the pipe.

Inasmuch as the curve is symmetrical, it is relatively easy to start with one line perpendicular to the circumference (which might be termed the zero line) and mark point *8* on both sides of this; then point *7* on both sides of this, then *6* and so forth. By continuing this process through all eight lines, the 16 points on the pipe surface, when connected, represent the cutting curve. The operator must allow for scarfing, as indicated in the first part of this article.

Convenient

The same process is applicable to the cutting of any of the other angles, as shown in the group of scales at the left of Fig. 5. The method is convenient and covers any size up to 16 OD on a single graph, permitting construction of the curve on the pipe with a minimum of material and labor. The diagram can easily be redrawn full size to reduce the amount of field converting of measurements. This requires a separate drawing for each angle ell, drawn to such size that the vertical scale at the left reads directly in inches.

A more general application of this method is shown in Fig. 6, a graphical means of determining the layout of pipe intersections for any ell-type angle connection. As in the example just outlined, the 16 distances are found and located. Assume that we desire to lay out a 45-deg ell on a 10-in. pipe. Then at 45 degrees, as shown in dashed lines in Fig. 6, we get the intersection points *1* to *8* inclusive. The points of intersection with lines *1* to *8*, are projected horizontally until they reach the line for 10-in. pipe. Then, downward on the graph, find dimensions in inches.

Although this method is rather simple, it is superior to templates in that it affords a means of determining ell cuts for any degree of bend. It is important to note that the pipe diameters are external and that the markings are for the actual intersection lines.

Templates for a 1-to-1-ratio tee connection, where both pipes are of exactly the same diameter, are shown in Figs. 3 and 4. These templates are drawn so that tee templates may be added between the given curves for any size desired, but they can be used only when both pipes are of the same size. When the ratio of pipe diameters is different, that is, not 1-to-1, the problem of laying out these intersections is somewhat more difficult.

[*Charts for reducing tees will appear in April* POWER—*Ed.*]

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An Old Story

THAT there's really very little that is new under the sun has been proved again by "Engineering and Boiler House Review", which describes a forced-circulation water-tube boiler built by Martin Benson of Cincinnati in 1856. The heating surface was composed of coils supplied from a distributing header into which water was pumped from the steam drum, and the boiler even had orifices in the coils to insure proper distribution between tubes.

Arizona Subway

Mile of tunnels distributes power services on University of Arizona campus saving 50% in maintenance and operation over former trench system

BY BACIL B WARREN
University of Arizona

MAINTENANCE and operating costs have dropped an estimated 50% since 5773 ft of service tunnels were installed at the University of Arizona, Tucson, to carry steam, water, electricity, telephone and gas lines to more than 20 buildings scattered over the campus. Built in 1931 to replace mains which then ran helter-skelter about the grounds in shallow trenches, this tunnel system has successfully combatted a severe corrosion and heat-loss problem caused by flood irrigation. With no radical changes, the layout has met heavy demands due to a new building program of unexpected size which has virtually doubled the load.

Plans, drawn up under the supervision of the University's building and grounds department, called for 3444 ft of 6x4-ft main tunnel, laid out in the shape of a U, and graded away from the central-heating plant (see Fig. 1). A 6x6-ft tunnel, 166 ft long, connects to the power house, and there are 2163 ft of 3x4-ft laterals. Construction cost, exclusive of piping, was $49,500, including inserts for adjustable pipe brackets, transformer rooms, three concrete stairways with ramps for sliding heavy material, and all iron work.

Open-cut excavations, averaging 10 ft in depth, were lined with 6-in. unreinforced concrete walls, and covered with 6-in. concrete roof, reinforced with ½-in. steel, 6 in. on centers. Roofs are recessed at the junction of main and lateral tunnels so that pipelines can cross, Fig. 3. The floor is of gravel, and rapid drainage is assured by the absence of surface water in this region and by the fact that all cuts run through sand. Manholes with ladder rungs set in the walls are at 200-ft intervals, with an 8-in. ventilator between each pair. Ventilators

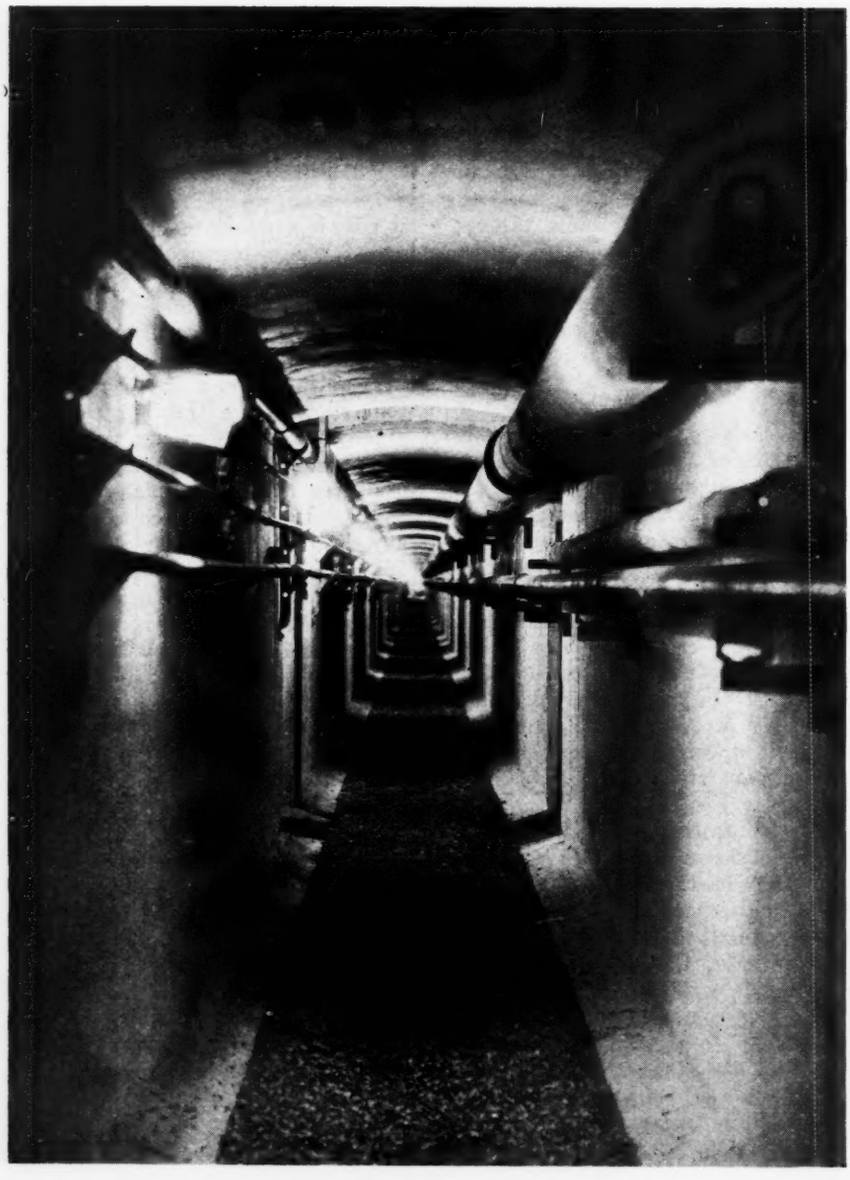


Fig. 2—Main tunnel south from power-house lateral. Electrical services on left, others on right

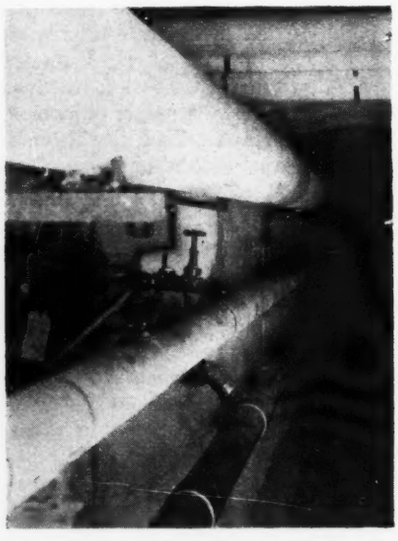


Fig. 3—Intersection, recessed roof and heating-system reducing valves

come directly to the surface, except when the tunnel runs under a roadway, when they are brought over to the side of a building.

The rather unusual procedure of piping the tunnels after completion was unavoidable, since the appropriation from the State Legislature was only enough for tunnel construction. Provision for later installation of pipe was made by building slanting pipe slides reaching from the roof to a point just under the surface of the ground. These slides were built at four places in the main tunnel and in each of the laterals, unless access though the building was convenient. To allow for future developments, slides were made large enough to handle 10-in. pipe in lengths up to 30 ft. Openings were covered with plugs in which packing grooves were employed to keep out water. Location of openings is recorded on the plans.

Steam piping on the south arm of the system was installed in 1932, as was all electrical equipment; the piping was completed in 1933. All work was done by University workmen, without appropriation of special funds.

Steam pressure is reduced at the plant from 125 lb to 40 lb, with one reducing valve for each of two distribution lines, one serving the north half of the U, the other the south half. Steam lines are welded throughout, with extra-heavy covering on all sizes above 3 in. Mains are dripped at three points. Slip expansion joints with bases anchored directly to the walls are placed at, or close to, each building lateral. Lines were checked with surveying instruments for both grade and alignment, and as a result it has been unnecessary, so far, to repack any expansion joints.

For ease of inspection, the reducing valves that bring pressure down to the 3-8 lb needed for radiation, are at the junction of each building lateral with the main tunnel, Fig. 3. Gages and relief valves protect against reducing-valve failure. Operation of the valves is controlled by pushbutton from a master panel in the power-plant building, Fig. 4. Pilot lights on the panel indicate whether the valve is in the open or closed position. Fig. 5 shows the Hornung electric control mechanism at the valve, and the valve and gage assembly. Repulsion-induction motors are used on all valves more than 800 ft from the boiler room.

Steam lines originally installed now serve eight new buildings not planned when the system was built. No main tunnel changes were necessary and laterals with piping were included in the contract price for each new building.

Return piping was laid out to serve a complete vacuum system, even though at the time of installation the gravity 1-pipe type was used in all the buildings. Since then, many have been changed to the 2-pipe system. Return lines are graded with the tunnel to electric float-controlled condensate pumps located in pump rooms at the tunnel ends, Fig. 6. These return the condensate to a receiver in the boiler room where it is lifted to the hotwell by a float-controlled steam pump. Return piping and the pump-discharge line on the north arm are copper, with cast bronze fittings; steel

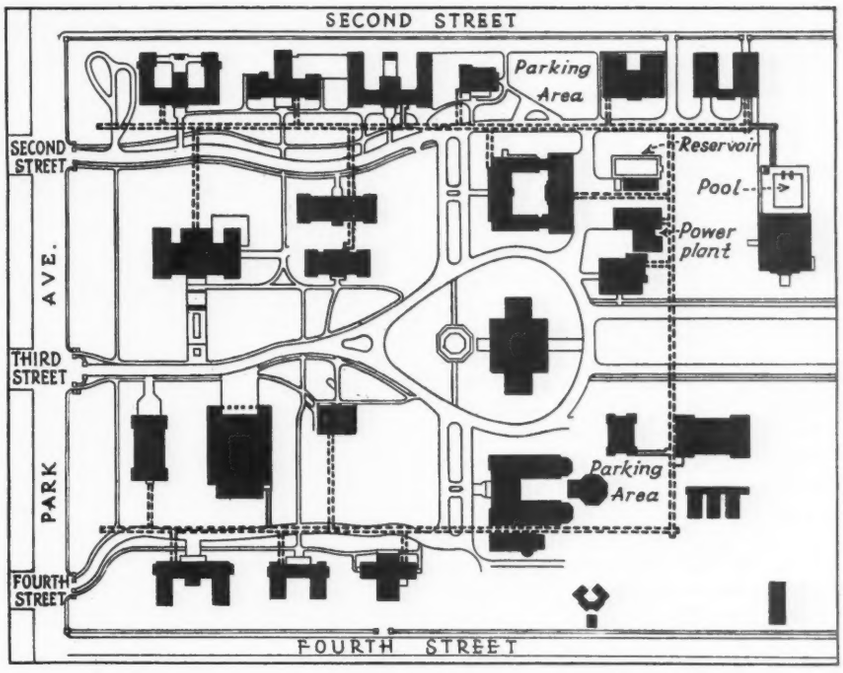


Fig. 1—Plan of campus showing tunnels and buildings

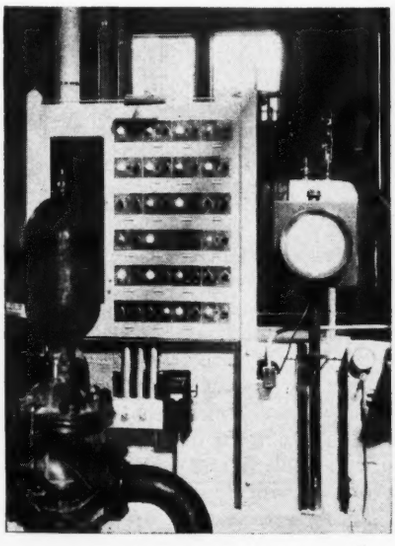


Fig. 4—Reducing-valve remote-control panel in power house

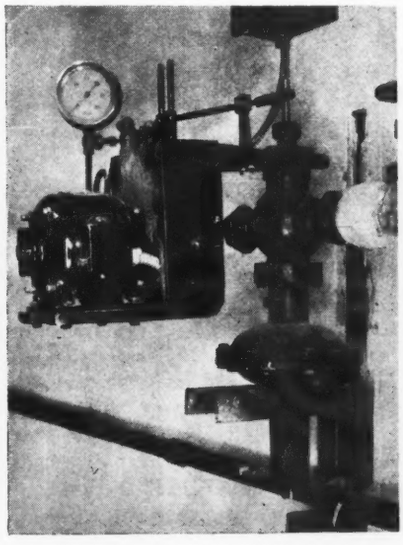


Fig. 5—Reducing-valve motor-driven operating mechanism

Fig. 6—Southwest entrance, showing fire main and condensate pump

is used on the south arm. Expansion is compensated for by slip joints anchored to brackets.

All return lines are covered with ½-in. wool felt insulation. This has proved a good investment, as the average receiver temperature is 158 F and tunnel temperature has been decreased.

The tunnel electrical system has handled the load increases brought by new buildings and has reserve capacity for even more expansion. Wiring for new buildings was simply tapped-in at junction boxes already located at likely spots for new construction. Current is brought to the edge of the campus on power-company lines, entering an underground conduit leading to the master meter and cutouts located in the main meter room in the tunnel. Distribution through the tunnel is by lead-covered cable insulated for 5000 volts, although the present supply is 2300. This is to care for a projected change by the city power company. Primary cable is carried in pipe conduit, supported on racks on the wall opposite the steam, gas, and water mains and telephone wiring.

The 110-220 volt current needed in the buildings is supplied from transformers in vaults outside the building lines, a safety factor in case of fire. One vault may serve two or more small buildings where convenient. Each has two ventilating outlets at the top, one extending to the floor level, giving constant circulation and keeping the transformers cool. Primary fuses for all transformers are in junction boxes in the main tunnel, at some distance from the transformers. These boxes are built flush to offer no obstruction. In case of fire in a transformer, fuses can be reached without entering the transformer room. For safety, all junction boxes are bonded and locked. The junction-box system permits cutting off buildings separately without interfering with the rest of the system. To permit cutting off groups of buildings, primary cutouts are located at various points on the campus.

Fig. 7—Transformers and meter assemblies in corner of vault

University meters are located in the transformer rooms, Fig. 7, so that consumption of each building is recorded. For certain self-sustaining buildings, all services are metered and billed to the individual building.

The tunnels also carry wiring for bells and clocks, fire-alarm boxes, remote control of steam valves, and for tunnel lighting. Lights are spaced at 20-ft intervals and are sectioned on a 3-way system, so that lights need only be turned on from section to section, and then only when the tunnel is entered.

Water and gas piping complete the story. The University pumps its own water from wells located at the eastern end of the campus, and distributes it through copper piping in the tunnels. High-pressure gas lines may be installed in the immediate future, according to present plans.

The entire layout is inspected twice daily: early in the morning by student labor, and later in the day by a regular maintenance man. Difficulties with maintenance have practically disappeared since this routine was established.

✦ ✦ ✦

Questions for Boiler-Room Engineers

By Harry M Spring

THESE QUESTIONS are similar to those asked in some of the better-arranged state examinations for licenses to operate steam boilers. Use them as an aid in interviewing and selecting power plant employees, and as a review of important features of boiler-room operating practice. From time to time Power will publish additional questions of this type.

Q—What harm would an obstructed blowdown pipe do?

A—There would be no water inside the pipe to prevent overheating, and if exposed to high gas temperatures, the pipe would probably overheat and cause damage through an explosion.

Q—What would happen if the top connection to the gage glass plugged?

A—The glass would fill rapidly, showing a false water level, but gage cocks would remain accurate.

Q—What would happen if the top water-column connection plugged?

A—The glass would fill rapidly, showing a false water level, and the gage cocks would be inaccurate.

Q—Would an obstruction in the lower connection cause similar trouble?

A—Yes, only the glass would fill more slowly.

Q—How would you clear a plugged glass connection?

A—If repeated opening and closing of the shutoff valve in the affected connection with the drain open, does not free it, close both shutoff valves and remove the glass. Open the valve in the defective connection with caution and put a bent piece of stiff wire through the open valve, taking care not to be burned. If this does not free the connection, the boiler must be shut down and the connection removed for repair.

Measured Grease Lubrication

Continuing his series of articles on lubrication, Professor Clower describes three centralized lubrication systems that will deliver a measured quantity of grease at the time you specify

By JAMES I CLOWER
Associate Professor of Machine Design, Virginia Polytechnic Institute

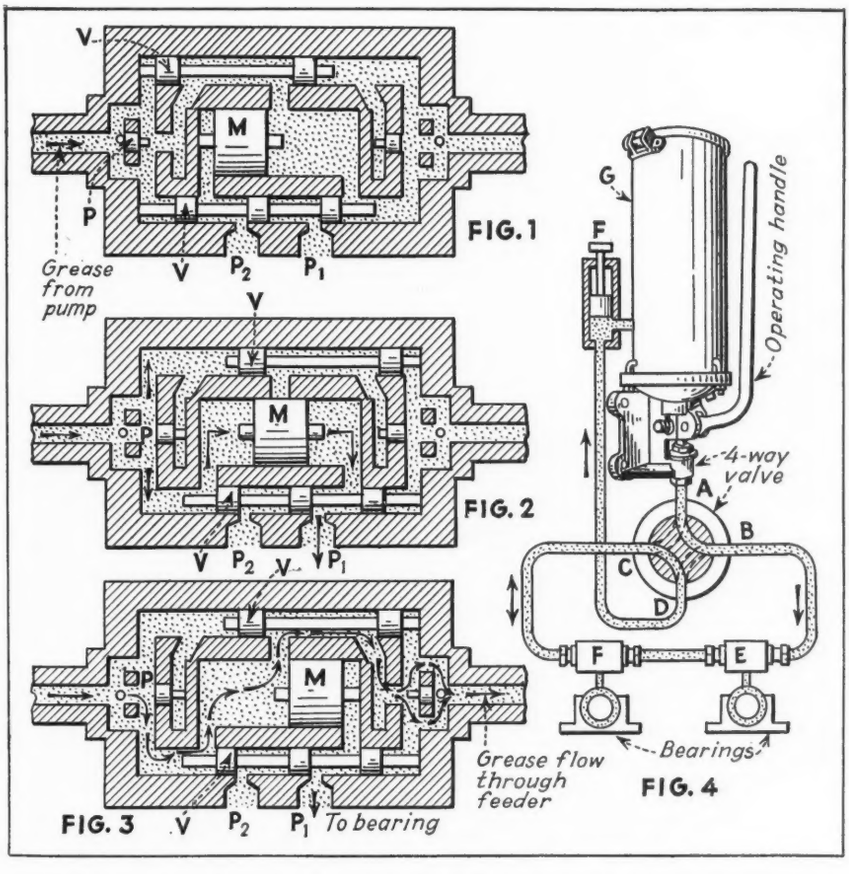
TO CIRCUMVENT time-consuming and unreliable point-by-point method of application, centralized greasing systems have been developed. These systems do not provide a continuous supply of grease, but frequency of application can be made practically continuous. They are made either in manual or automatic-mechanical types. When conditions require an application frequency of less than 4 hours, an automatic-mechanical type is usually recommended.

Even though a centralized system does not reuse grease, it may be more efficient than a circulating oiling system, under some operating conditions, because grease generally will remain in a bearing longer than oil. Ordinarily it is not possible to lubricate all bearings with the point-by-point method when a machine is in operation. A centralized system not only permits lubricating the machine in operation, but also reduces the application hazard in lubricating hard-to-get-at bearings.

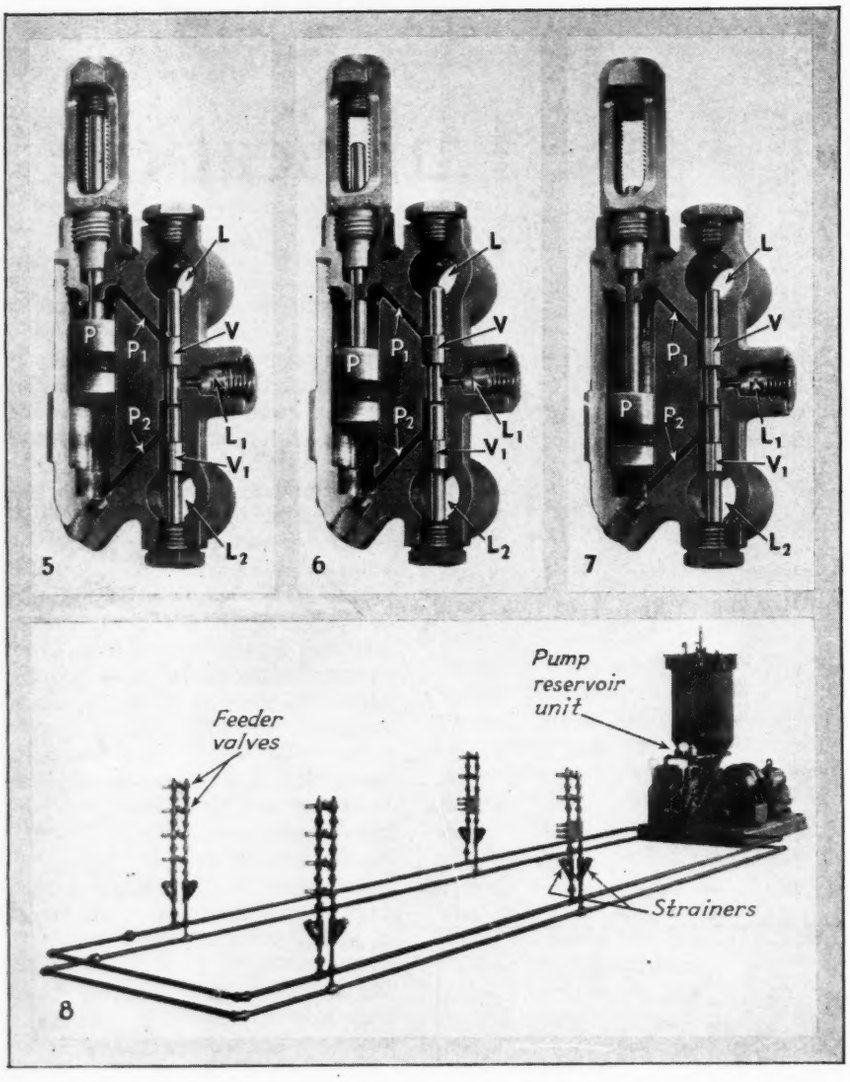
Centralized grease systems are widely used for all sorts of metal-forming machines, such as presses, punches, shears, and for machinery in the steel, rubber, paper, printing and textile industries. These systems centralize the points of application by a central combination pump-reservoir unit, which may be manually, air or electrically operated; a measuring or feeder valve located at each point of application; and the necessary piping or tubing and fittings for conveying grease from the central unit to each individual bearing.

The heart of these systems is the measuring or feeder valve, one design of which, for a single-line system, is shown in Figs. 1 to 3. A central pump forces grease into the feeder from left to right, Fig. 1. Primary piston *P* and sliding valves *V* are moved to the right, Fig. 2. This action of the primary piston and sliding valves admits grease to the main cylinder and forces the main piston *M* to the right. From the previous operation or cycle, the cylinder to the right of the main piston is full of grease, which is forced through port P_1 to the bearing. In Fig. 3, the main-piston plunger has completed its stroke and forced a measured quantity of grease into the bearing. In this position, grease is free to flow through the valve acting as part of the circuit, to operate the next feeder and lubricate the next bearing. This process continues until each feeder in the system has operated to deliver a measured quantity of grease to its respective bearing. Then, no more grease can be forced into the bearings until the 4-way valve at the pump is reversed, which may be done automatically or manually. The 4-way valve reverses grease flow in the circuit and the cycle is repeated, but from right to left.

The single-line system, using feeder valves Figs. 1 to 3, with a manually operated pump, is illustrated in Fig. 4. Grease forced by the pump into the 4-way valve at *A* leaves at *B* and goes



Figs. 1 to 3—Steps in the operation of an automatic grease-measuring feeder valve for a single-line series system. Fig. 4—Manually operated pump, 4-way reversing valve and two feeder valves for a single-line system



Figs. 5 to 7—Three positions of a feeder valve for a dual-line system. Fig. 8—Central-pump reservoir, piping and the feeder valves for a dual-line grease-lubrication system

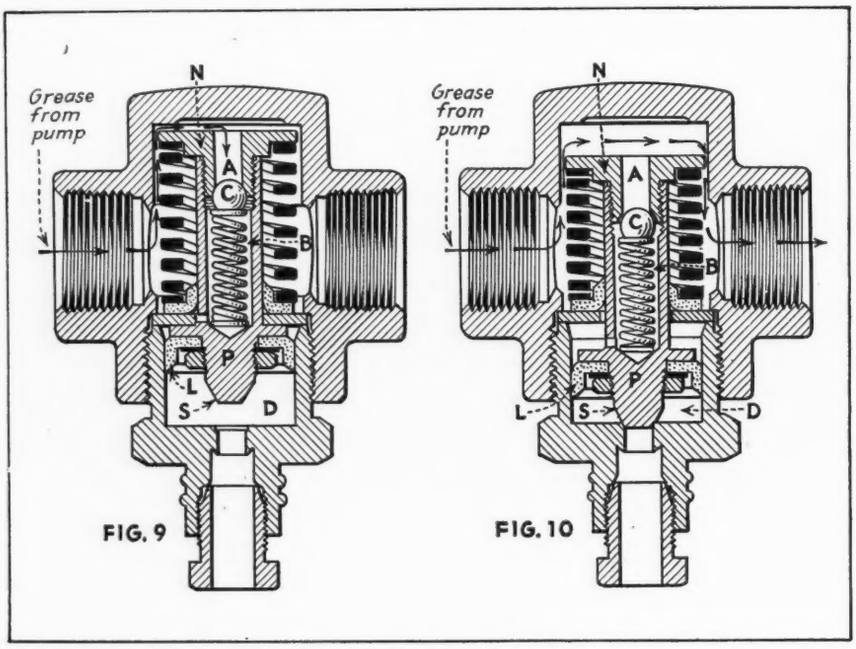
to feeder valves E and F, back into the 4-way valve at C and out at D to positive indicator F and reservoir G. Turning the 4-way valve 90 deg clockwise will bring the passages through it to the position shown by the dotted lines. Then grease flow will be reversed beyond the 4-way valve. That is, it will enter at A, flow to C, through the line to B, out at D and return through indicator F to the reservoir. The line from and to the 4-way valve can be any length, and can have almost any number of feeders connected in series, each serving a bearing.

Figs. 5 to 7 show a design of feeder valve for a so-called dual-line system. Position of its various parts when grease under pressure from the pump first enters the feeder at the line connection L. is shown in Fig. 5. Top piston valve V is first moved downward, thereby permitting the grease to flow through port P_1 to the chamber above the piston P, which is moved downward, Fig. 6. Downward movement of piston P forces grease from the lower chamber through port P_2 past the lower piston valve V_1 into the bearing through connection L_1, the lower chamber having been filled with grease from the previous operation. In Fig. 7, valves and piston have completed the operation. Next operation or application of grease to the bearing occurs in the reverse order, grease from the pump entering the feeder at line connection L_2.

Dual-Line System

Fig. 8 shows a dual-line automatic system comprising a central pumping reservoir unit, two main distributing lines, and feeder valves, Figs. 5 to 7, located at each bearing. The central unit includes an electric motor, double plunger pump, 4-way hydraulic reversing valve, speed reducer, adjustable accumulator, and a suitable grease reservoir. The pump unit alternately delivers grease to both main distributing lines at high pressure throughout the circuit. Pressure applied to either of the lines causes feeders connected to them to discharge a measured amount of grease to each bearing, and at the same time, recharge feeders for the next operation. The 4-way reversing valve at the pump alternately delivers grease from the pump to each of the main distributing lines. An adjustable pressure control valve can be set for practically any pressure.

Frequency of operation is hydraulically controlled. The system can be electrically controlled, but the hydraulic method is generally preferred because of its simplicity. The accumulator is adjustable and acts as



Figs. 9 and 10—Before and after, respectively, operation of a spring-loaded automatic feeder valve

a simple expansion chamber to receive a predetermined quantity of grease at each cycle of operation, before pressure can be built up in the line to discharge all feeders. With the pump delivering a fixed quantity of grease per unit of time and because the accumulator must be filled at each cycle of operation, capacity of the accumulator directly affects the length of time required for one complete operating cycle.

Figs. 9 and 10 show a spring-loaded feeder valve in normal and discharged positions. When pressure is applied at the pump, grease is forced into the feeder up past the hexagonal nut *N* into chamber *A*, past ball check valve *C* into chamber *B*. This action causes the leather-packed plunger assembly *P* to move downward into chamber *D*, thereby forcing the grease charge into the bearing. When plunger *P* is stopped by stem *S*, no more grease can be forced into the bearing and the grease is free to flow through the feeder, Fig. 10, to the next feeder in the circuit.

When all feeders in the circuit have been discharged and pressure released at the pump, the large helical spring pushes the plunger assembly upward, thereby subjecting grease in chamber *B* to pressure. Since the grease is prevented from escaping back into the line, by ball check valve *C*, it is forced by cup leather *L* into chamber *D*, thus charging the feeder for the next operation. This feeder is so designed that no more grease than the volume of chamber *D* can be forced into the bearing at one application.

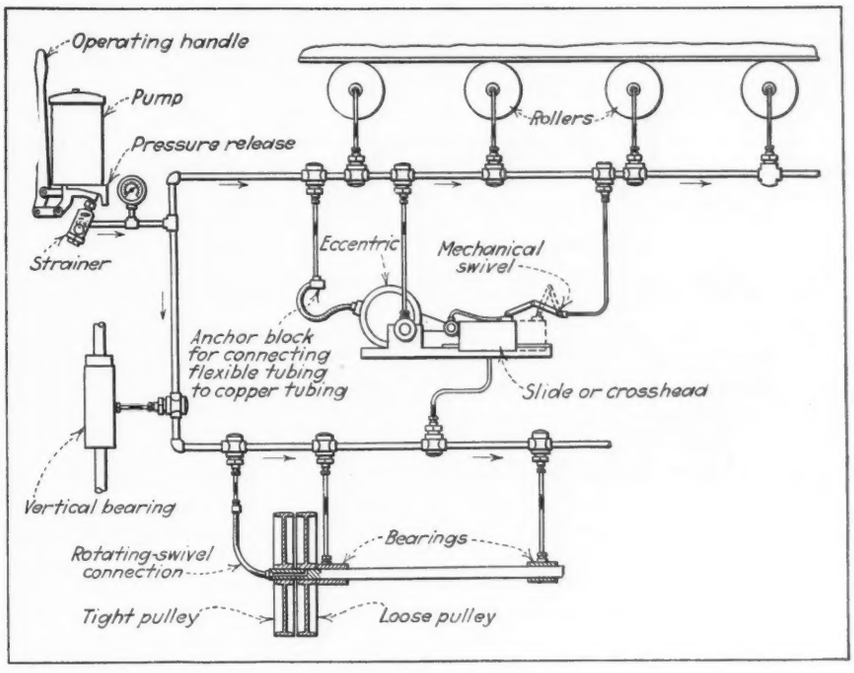


Fig. 11—Schematic diagram showing possible applications of spring-loaded feeder valve in Figs. 9 and 10

Fig. 11 is a schematic diagram of a manually operated system employing these feeders. This system comprises a central pump-reservoir unit, which may be mounted at any convenient place on or near the machine, feeder valves, and necessary piping, fittings, etc., for connecting the pump-reservoir unit to the bearings. The pump is actuated until a line pressure of 2,000 lb is built up. Then pressure is released into the line by a valve at the pump, at which time a measured quantity of grease is forced into all bearings by the feeders.

Information for preparation of this article was supplied by the Trabon Engineering Corp, Cleveland, O.; The Farval Corp, Cleveland, O., and Stewart-Warner Corp, Chicago, Ill.

Exhaust Lines

A British firm has been awarded a million-dollar contract to pipe the earth's heat to buildings in Reykjavik, Iceland. Borings have increased the capacity of the nearby springs to 40 gal. of hot water per second. In six months, it is predicted, half the houses in Reykjavik will be heated by the natural hot water. Estimated coal savings of 100% per installation is the biggest yet brought to *Power's* attention.

An employee of the Utah Power and Light Co reported recently that 42 eagles had been electrocuted in one week. If this weakness for roosting on high-tension equipment isn't overcome pretty quickly, Congress may have to designate the rooster as the national bird.

Speaking of oil, lubricant in steam-engine exhaust is always a problem for power engineers. A Swiss engine designer solves it by omitting the lubrication. Instead of piston rings, his engine has labyrinth grooves on both cylinder walls and piston. Sounds like a lot of bumping and scraping, but they say there is none, because the piston is so guided that it doesn't touch the cylinder. Another labyrinth packing in the piston-rod gland keeps out crosshead and crank-case oil.

Engineers installed air conditioning in a brokerage office and guaranteed that the unit would maintain 70F in the room. The broker must have read the story of Shylock. At any rate he figured that 70 meant 70, with no leeway at all. Every time the thermometer got a hair off the line one way or the other he grabbed the telephone until he had the engineers nutty. But they fixed him finally; put in a thermometer that would read 70F and nothing else. "What you don't know won't hurt you."

A train built almost entirely of glass—some 200 varieties—is now starting a 2000-mile tour of England to show the use of glass as a decorative medium. Strips of mirrored glass run the full length to form 120,000 miniature mirrors, and walls, floors and ceilings, as well as interior fittings, will be made of the stuff once thought fragile. Outstanding in the display is armour-plate glass—it can be twisted through an angle of 30 deg without breaking and will stand temperatures from minus 94 F to almost 600 F.

Some of you have probably wondered why there's an odd number of divisions (180) between boiling and freezing on the Fahrenheit thermometer. According to a thumbnail biography in Esso Oilways, *Herr Fahrenheit was a maker of astronomical instruments, so he had equipment for dividing circles into degrees of arc. Apparently he adapted this to the job of dividing his newly-designed thermometer, which explains the 180 deg—half of 360.*

Keeping Tabs on Steam

These plant-tested forms summarize steam-generating costs and give an unusually detailed breakdown of maintenance costs, too often neglected.

ALFRED VAKSDAL, plant engineer at Corning Glass Works, believes in power-cost accounting, but likes some systems better than others. One of his pet peeves is what he calls the "sewer system of accounting". This system seems to be a favorite with some, (not all), of the professional accountants who serve industry. The basic idea of this "sewer system" (it isn't patented, unfortunately) is that you account in great detail for all the items you understand and throw all the others down the sewer by lumping them together under some general head. This makes the total come out right and is supposed to keep everybody happy, on the theory that what you don't know won't hurt you.

REPORT OF STEAM GENERATION

Plant _____ Engineer _____ Period _____

No.	ITEM	UNIT	UNIT COST	NUMBER OF UNITS	TOTAL COST (EVEN DOLLARS)
1	Electricity	KwHr	$		$
2	LP Steam	M Lb			
3	Coal	Tons			
4	Oil	M Lb			
5	Gas	M Cu Ft			
6	Water	M Lb			
7	Other Materials				
8	Operating Labor				
9	Maintenance				
10	Supplies & Misc				
11	Supervision				
12	Total Operating Cost				
13	M Lb Net Steam Delivered				
14	Unit Cost Per M.				

OPERATING DATA

15— Steam Press _____. 16— Superheat _____. 17— Briefly describe fuels (include Btu).

18— Describe boiler units very briefly. Give heating surface, how fired and whether economizers or air heaters are used. Omit fine details.

_____

_____

_____

19— Net boiler plant evaporation per pound of coal as fired, _____

20— Same "f & a 212°", _____. 21 Net boiler-plant efficiency, _____

Fig. 1—Summary of steam-generating costs

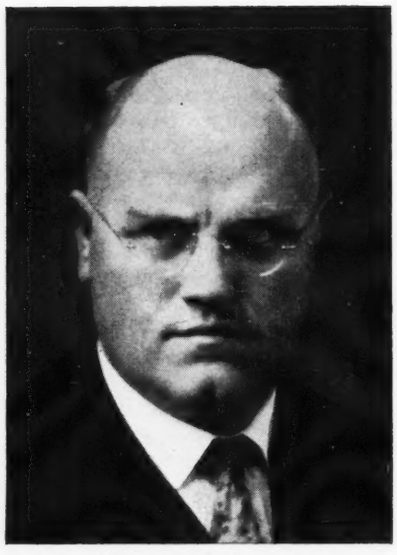


Fig. 2—Alfred Vaksdal, plant engineer of Corning Glass, is chairman of the committee which produced these tested cost forms

Let's say, for example, that you are a hotel-cost accountant. That means you are a great expert on food. Naturally you set up elaborate food forms to cover food costs from every angle. When you get to the power department you discover a maze of pipes, engines, boilers, heaters and compressors, which don't mean a thing to you because you never studied engineering. So you get around your mental difficulties by setting up a "sewer account" for all power items. You call it "Heat, Light and Power", and get a figure to go under this heading by adding up all the expenditures for coal, oil, mechanical supplies, engineering salaries, labor, etc. This total conceals hundreds of preventable power wastes which eat up most of the handsome profits made by the hotel cocktail room.

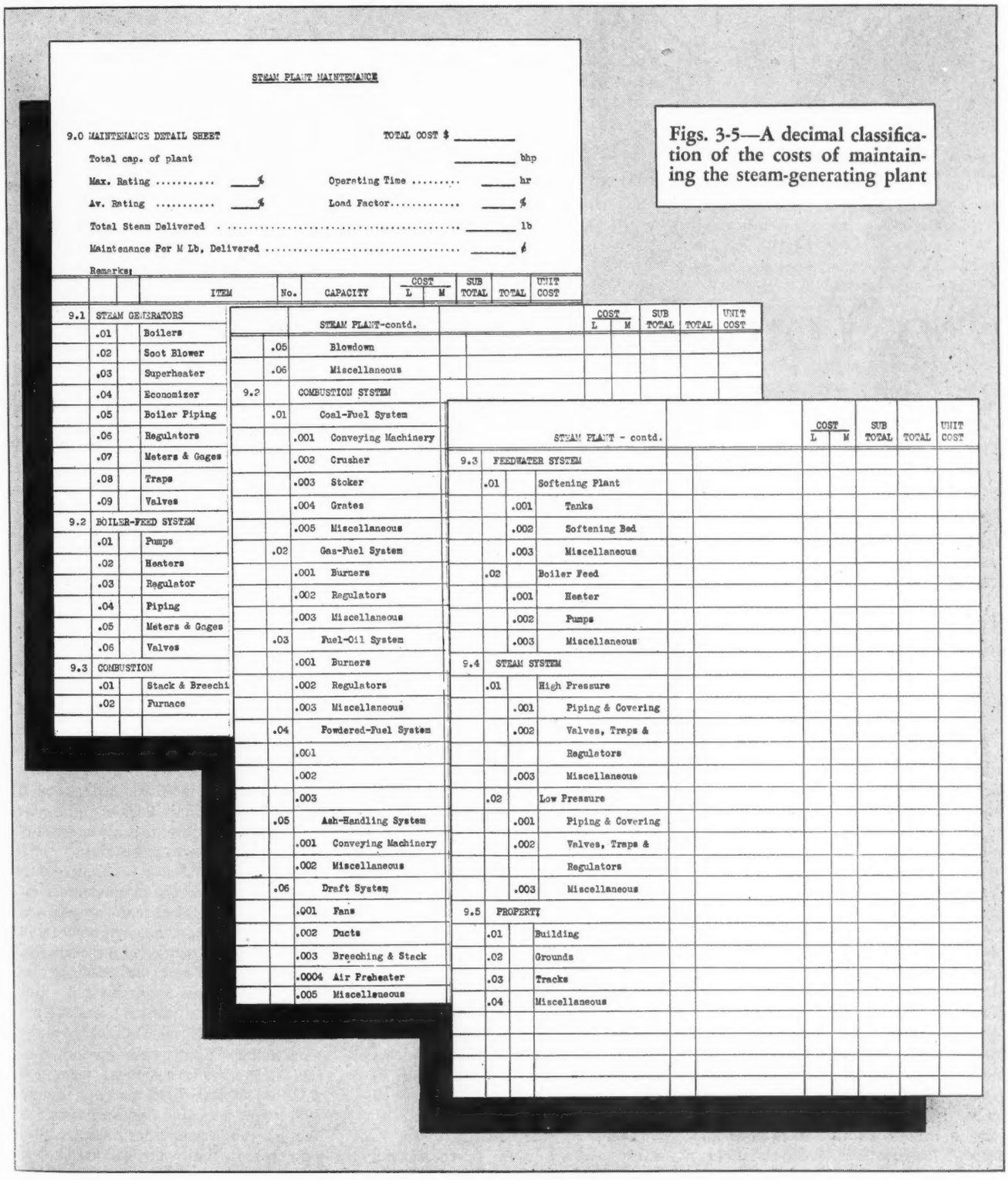
Vaksdal doesn't like that kind of accounting, whether it is applied to a hotel, a glass factory, or a saw mill. He figures that a cost system should increase profits by eliminating waste of materials and man hours and that you can't eliminate these wastes until you know where and what they are. That's why Al Vaksdal has given a lot of attention to maintenance costs in recent years. He knows that sloppy maintenance and sloppy maintenance-cost accounting wastes millions annually and he proposes to eliminate most

of that waste as far as Corning Glass is concerned.

With this little preamble, let's look at the cost forms. Each year, at the time of the annual ASME meeting, a group of well-known industrial power engineers meets at luncheon in New York to discuss plant problems of mutual interest. They talk a lot about costs and, quite naturally, picked Vaksdal to head their "Power-Cost" sub-committee.

Attached are two sets of forms developed by the committee for general industrial use, with the understanding that they may need some modification to fit local conditions. Figs. 3, 4 and 5 are the three sheets of a maintenance-accounting form, devoted exclusively to the cost of maintaining steam-generating equipment. Note the use of a decimal system to classify the charges, so that you can tell just what it costs in material and labor to maintain each major element of the steam-generating system.

Many readers will be interested in Fig. 1, which shows the Committee's form for summarizing the major elements of steam-power cost. This particular form was made ultra simple to encourage its use by industrial-power engineers as a standard means of comparing steam costs in different plants. It does not in any way displace some more elaborate forms on which every engineer should record the cost performance of his own steam plant for his personal information.



STEAM PLANT MAINTENANCE

9.0 MAINTENANCE DETAIL SHEET — TOTAL COST $ _____

Total cap. of plant _____ bhp

Max. Rating ..... ____% Operating Time ..... ____ hr

Av. Rating ..... ____% Load Factor..... ____ %

Total Steam Delivered ..... _____ lb

Maintenance Per M Lb. Delivered ..... _____ ¢

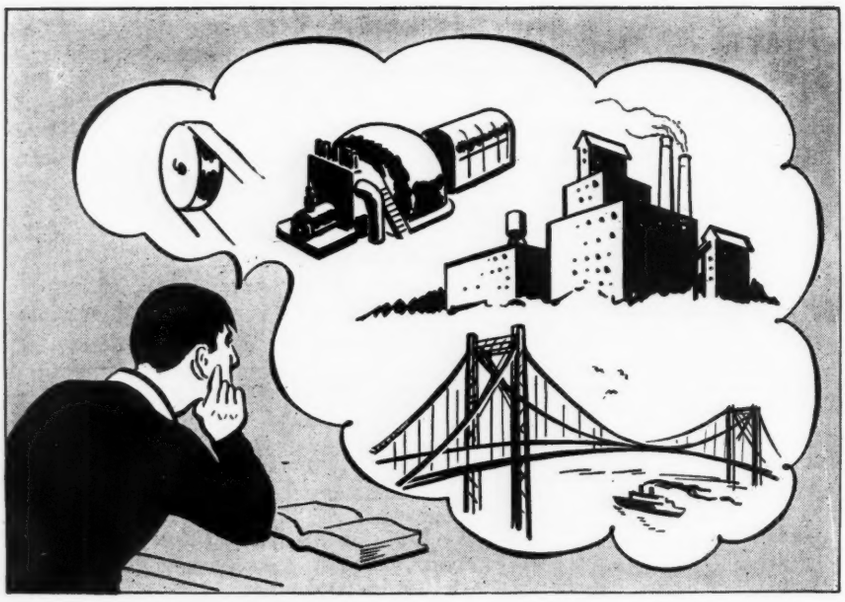
Remarks:

			ITEM	No.	CAPACITY	COST L	COST M	SUB TOTAL	TOTAL	UNIT COST
9.1			STEAM GENERATORS							
	.01		Boilers							
	.02		Soot Blower							
	.03		Superheater							
	.04		Economizer							
	.05		Boiler Piping							
	.06		Regulators							
	.07		Meters & Gages							
	.08		Traps							
	.09		Valves							
9.2			BOILER-FEED SYSTEM							
	.01		Pumps							
	.02		Heaters							
	.03		Regulator							
	.04		Piping							
	.05		Meters & Gages							
	.06		Valves							
9.3			COMBUSTION							
	.01		Stack & Breechi							
	.02		Furnace							

			STEAM PLANT-contd.	COST L	COST M	SUB TOTAL	TOTAL	UNIT COST
	.05		Blowdown					
	.06		Miscellaneous					
9.2			COMBUSTION SYSTEM					
	.01		Coal-Fuel System					
		.001	Conveying Machinery					
		.002	Crusher					
		.003	Stoker					
		.004	Grates					
		.005	Miscellaneous					
	.02		Gas-Fuel System					
		.001	Burners					
		.002	Regulators					
		.003	Miscellaneous					
	.03		Fuel-Oil System					
		.001	Burners					
		.002	Regulators					
		.003	Miscellaneous					
	.04		Powdered-Fuel System					
		.001						
		.002						
		.003						
	.05		Ash-Handling System					
		.001	Conveying Machinery					
		.002	Miscellaneous					
	.06		Draft System					
		.001	Fans					
		.002	Ducts					
		.003	Breeching & Stack					
		.0004	Air Preheater					
		.005	Miscellaneous					

			STEAM PLANT - contd.	COST L	COST M	SUB TOTAL	TOTAL	UNIT COST
9.3			FEEDWATER SYSTEM					
	.01		Softening Plant					
		.001	Tanks					
		.002	Softening Bed					
		.003	Miscellaneous					
	.02		Boiler Feed					
		.001	Heater					
		.002	Pumps					
		.003	Miscellaneous					
9.4			STEAM SYSTEM					
	.01		High Pressure					
		.001	Piping & Covering					
		.002	Valves, Traps & Regulators					
		.003	Miscellaneous					
	.02		Low Pressure					
		.001	Piping & Covering					
		.002	Valves, Traps & Regulators					
		.003	Miscellaneous					
9.5			PROPERTY					
	.01		Building					
	.02		Grounds					
	.03		Tracks					
	.04		Miscellaneous					

Figs. 3-5—A decimal classification of the costs of maintaining the steam-generating plant



"So You Want to be an Engineer"

Does your son want "to study to be an engineer," or do you know some high-school boy who seeks your advice? If so, you will be interested in this letter from a practising engineer to his nephew. Case and letter are real, so names are withheld

"DEAR BILL:

You will graduate from high school next June. Your father tells me you want to be an engineer (not just sure what kind), and asks me to advise you regarding your education and summer jobs. I am mighty glad to do this, because I think you have the ability to go places in engineering if you get the right start. For many years I have been thinking about this matter of job preparation and noticing which men got ahead and which didn't and why. I have discussed job training with many college professors and with successful engineers and business men in many industries.

"To get us right down to brass tacks, I have laid out the attached job-preparation chart, which sums up my own observations and convictions.

"No two men ever see things exactly alike, yet I feel, Bill, that the average engineer of long experience will admit that this chart is at least 80% right. Certainly all successful business men and engineers agree about the importance of getting along with people and of being able to express yourself successfully in writing and in speech.

"A few engineers, and many of the professors, might claim that I have overstressed the importance of picking up a lot of practical skills *before* graduating from engineering school. Yet the longer I live the more certain I become that certain elementary skills are as fundamentally useful as Ohm's law and the multiplication table, because they enter into every move the engineer makes in actual life.

"Don't get the idea that you can safely postpone some of these things until after you get your diploma. Did you ever hear of a great musician who confined himself to the theory of music in his early years and didn't start thumping the piano until he was twenty five? No, youth is the time to learn to play an instrument, to skate, swim, ride a horse, sail a boat, dance, get along with people. run a typewriter. I can't see any good reason why you should wait until after graduation before learning how to write a business letter, swing a hammer, push a file, sell a bill of goods or get along with a bunch of workmen.

Land on Four Feet

"Before I explain how to use the job chart, I must deliver one more piece of advice, based on long experience and observation. You've probably read inspiring stories about men who start young preparing for one specific job. In general, I don't think it's a good plan, although there have been spectacular exceptions. I'm not underestimating the importance of having a definite purpose in life, but feel that too-early specialization is very dangerous. Observe the ways of the cat, Bill. She knows more than one way to jump. Her outstanding talent is the ability to land on four feet under any and all circumstances.

"To be safe you've got to be versatile. How many men today are actually in the jobs they picked for themselves 20 or 30 years ago? How can you be sure about what you will be doing in 1958? When that day arrives, the job you planned may not even exist, or the rapidly changing world may have created a new, and much better, opportunity for you somewhere else. There is always a lot of chance and uncertainty in human affairs. Above all things, prepare yourself to land on four feet no matter where you are tossed. That means being able to do those simple every-day things that enter into all jobs everywhere.

"I hope you get this point, because it is important. Don't decide right now that you are going to be an air-conditioning engineer or a diesel engineer (whatever that is). Train yourself in the general fundamentals of mechanical and electrical engineering. At the same time, acquire some skill in the simple every-day operations of all engineering and business occupations. I repeat, start right now learning how to talk and write English, work with people, sell, handle tools and machines, write business letters, keep simple accounts. Then you will be equipped to make a living with your hands and end as far up the line as your head, your adaptability, your energy and your good luck can carry you.

"It's about time I explained that job chart. The names at the top of the columns indicate general classifications of jobs. Starting with an engineering slant, you are almost certain to land in one of these classifications eventually, but it's hard to tell which at this distance. Therefore prepare, to some extent, for all of them.

"Down the left-hand side of the chart I have listed important elements of job preparation and background. These are grouped as *general skills, special skills, field experience* and *college studies.* Every one of the listed items is part of the necessary preparation for some job or other. Most of them would be helpful in a hundred different jobs.

Rating Chart

"The next thing I did was to consider how much value each element of this imaginary preparation would have after you were well established (say 15 years from now) in any one of the general job classifications. I have rated a particular item of preparation *1* where you would find it essential or extremely important and *2* where it would be helpful, but less essential. You will better understand what I mean if you will look at the line *shop mechanic.* Early shop training has real value in any job you may later get, but it will be more important in some lines than in others. I rate it *2* if you later become a sales engineer and *1* if your final job is on the engineering side of factory work.

"To simplify matters, I have considered only the requirements of the advanced job. That is why, for example, I have listed sales experience and ability as a *number 1* requirement for engineering research. That might not seem to be necessary, but it will be if you ever become a research executive faced with the problem of 'selling' ideas to your staff and of 'selling' the financial heads of your company the necessity of an adequate research budget.

"If you look through the various columns you will find that certain background elements, particularly the first three, are essential to success in any job you might get. Now isn't it just common sense to equip yourself as soon as possible with those skills that will help you to earn a living and move ahead no matter where you may land.

"You may not particularly admire the man who goes through life smoothly by shaking hands, writing smart letters and talking glibly, but the fact that it is done so often proves that these abilities have tremendous commercial value. Now your mind is constructive; a comfortable existence as a 'hot-air artist' wouldn't satisfy you. You propose to do useful things and know what you are talking about. Fine; you are in line to become a useful citizen! Nevertheless you must add the qualifications of a salesman to fundamental worthiness if you expect to accomplish much, certainly so if you seek the maximum personal return in salary and recognition.

"What every salesman has is 'ability with people,' listed under 'General skills.' By this I mean the ability to win the friendly cooperation of all kinds of people, to get along with your boss, your equals and men under you, to get along with those to whom you sell and from whom you buy. No matter what title may be engraved on your business card, you will find that life is largely *selling.*

"If the engineer cannot get other people to help him put his sound ideas into action, his technical knowledge has no commercial value and he himself will never be able to hold a good job, regardless of his engineering ability.

"When it comes to *writing ability,* I haven't in mind so much the writing of articles as the ability to write business letters, reports and notes that will put the recipient in the right frame of mind and get things done the way you want them done. Bad letters and clumsy reports will get you nowhere fast. *Talking ability,* of course, includes the ability to keep your mouth shut at the right time. It might be defined as the ability to use spoken words (plus discreet silence) to make people think well of you and cooperate with you.

"There won't be enough summers between now and your graduation from college for you to get extended experience in all the indicated fields. If you must choose, I suggest that you spend at least one summer in a shop. Be sure to get some greasy job in overalls, running a machine, chipping castings, helping machinists or millwrights, oiling engines or something like that close to nature. Learn how men feel toward a boss, which qualities they like in him and which they don't. Learn how it would be wise for you to behave when you get to be a boss. Begin to get that 'shop sense,' for the lack of which some smart theoretical engineers suffer.

"It would be a good idea to spend one summer in a store. You might work in a hardware store, or you might deliver groceries. This will teach you the simple little things about every-day business, about keeping a lot of details straight and keeping customers satisfied. Most important of all, it will initiate you into the mysteries of salesmanship.

"I could keep talking all night on this subject of job preparation, but I haven't the time and I guess you can get the idea from what I have said and from studying the chart. And though you've got some tough years ahead, there will be lots of fun, too, if you go at it right.

Your Uncle"

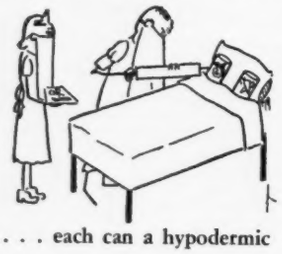
[*A few clippings of this article are available. While they last, single copies will be sent without cost, to readers who request them—Editor.*]

PREPARATION AND BACKGROUND			FINAL JOB: Design	Engineering Selling	Factory (business end)	Factory (engrg. end)	Construction	Consulting engineer	Power engineer	Research
	General Skills	Ability with people	1	1	1	1	1	1	1	1
		Writing ability	1	1	1	1	1	1	1	1
		Talking ability	1	1	1	1	1	1	1	1
	Special Skills	Handling tools	1	2	2	1	1	1	1	1
		Speeches	2	1	1	1	2	1	2	2
		Writing letters	1	1	1	1	1	1	1	1
		Writing reports	1	1	1	1	1	1	1	1
		Bookkeeping	2	1	1	1	1	1	1	2
		Typing	2	2	2	2	2	2	2	2
		Freehand drawing	1	2	2	1	1	1	1	1
	Field Experience (Summers)	Shop mechanic	1	2	2	1	2	1	1	1
		Construction	2	2	2	2	1	1	1	2
		Office	1	1	1	1	1	1	1	1
		Selling	1	1	1	1	1	1	1	1
		Drafting	1	2	2	1	1	1	1	1
	College Studies	English	1	1	1	1	1	1	1	1
		Physics	1	2	2	1	1	1	1	1
		Chemistry	1	2	2	1	2	1	1	1
		Math	1	2	1	1	1	1	1	1
		Drafting	1	2	2	1	1	1	1	1
		Economics	2	1	1	1	1	1	1	1
		M.E. studies	1	2	2	1	1	1	1	1
		E.E. studies	1	2	2	1	1	1	1	1

Speaking of Power

A lot of interesting mail passes over my desk in the course of a day. Here's a sample from Harry McAllister, Philadelphia: "Sometime in the early eighties I saw *Power* in a store window, along with *Puck, Judge* and other publications of the good old days. I bought it and have since been a steady subscriber. I still have the original papers on file." . . . When you stop to think of it, *Power* is pretty old, considerably more than half a century. Yet we like to feel that there is nothing elderly about our attitude toward power generation or life in general. Perhaps the secret is that we have a very old tradition of being always young.

The newspapers recently announced a canning process in which each can is given a hypodermic injection with steam. Cuts the sterilizing time from half an hour to twenty seconds. . . . It's my guess that the future will see many other examples of heating and cooling



. . . each can a hypodermic

from the inside out, instead of from the outside in. Already we have the so-called "panel heating," in which wall radiation heats the occupants more than it warms the room air. The more spectacular "fever machine" induces electric currents in human flesh and thereby heats the flesh of the patient from the inside without baking his skin. The induction melting furnace, in the same way, heats metals without applying any heat, as such. . . . And don't forget water-vapor refrigeration. A high vacuum over the water surface lowers the boiling point so far that the water "flashes cold" throughout its entire mass. This process is already being used to cool liquid foods (e.g., milk and tomato juice) without coils, jackets or other heat-transfer elements. . . . This gives me the idea that we may some day cool individual drinks by pulling a flexible tube out of the wall, clapping an air-tight cap on top the container and turning a valve to connect the container to a

. . . cool drinks

central vacuum system. The whole mass of liquid will then be cooled instantly to a temperature precisely controlled by the degree of vacuum. Some day buildings may advertise "central vacuum in all rooms," just as they used to advertise "running water" long ago. . . . From the drink angle, the only visible hitch in this scheme is that alcohol evaporates faster than water.

Back in the latter part of January, when everybody was talking about the "recession," you would never have suspected its existence if you had visited the Heating and Ventilating Exposition in New York's Grand Central Palace. Three solid floors of the great exhibition hall were packed solid with every conceivable variety of equipment for cooling, heating, washing and filtering air. The place was so crowded with visitors you could hardly move around. . . . I was particularly impressed with the tremendous amount of competition in air-conditioning equipment. It seemed that everybody and his brother was trying to share the great harvest of new orders in this field.

. . . harvest of orders

If you like those special sections we have been running (a lot of readers tell us they do), keep an eye out for "Electrical Applications" in April. It is already nearing completion, after months of editorial work, and will contain more useful information per page than you have yet seen on this subject of such universal interest to power engineers. . . . June *Power* will feature a section on pumps, another bread-and-butter subject. The more I see of power plants of all varieties the more I am convinced that pumping is one of

. . . bread-and-butter subject

the most universal and important parts of the power engineer's job.

No part of my work is more interesting than the opportunity for personal contacts with the engineers who are laying the technical foundations for a greater America. I have recently had most interesting conversations with Charles Kettering, who heads research for General Motors, and with Willis H Carrier, air-conditioning pioneer. . . . As many of you know, the Carrier Corporation has now consolidated all of its manufacturing activities in Syracuse, N.Y. In February I went up there to study their operations and meet their executives and engineers. Mr. Carrier, who has been active in air conditioning since 1907, had much of interest to offer. For one thing he pointed out that air conditioning has had a geometric growth since the art was founded, business doubling regularly every three or four yrs. Speaking of the industry as a whole, as well as of his own company, Mr. Carrier believes that this rate of growth will continue for many years to come and that the national air-conditioning sales volume 12 years hence may quite possibly exceed one billion dollars.

Coming right back to the present, I'm sure you will find a lot of good practical tips in this March number. I would

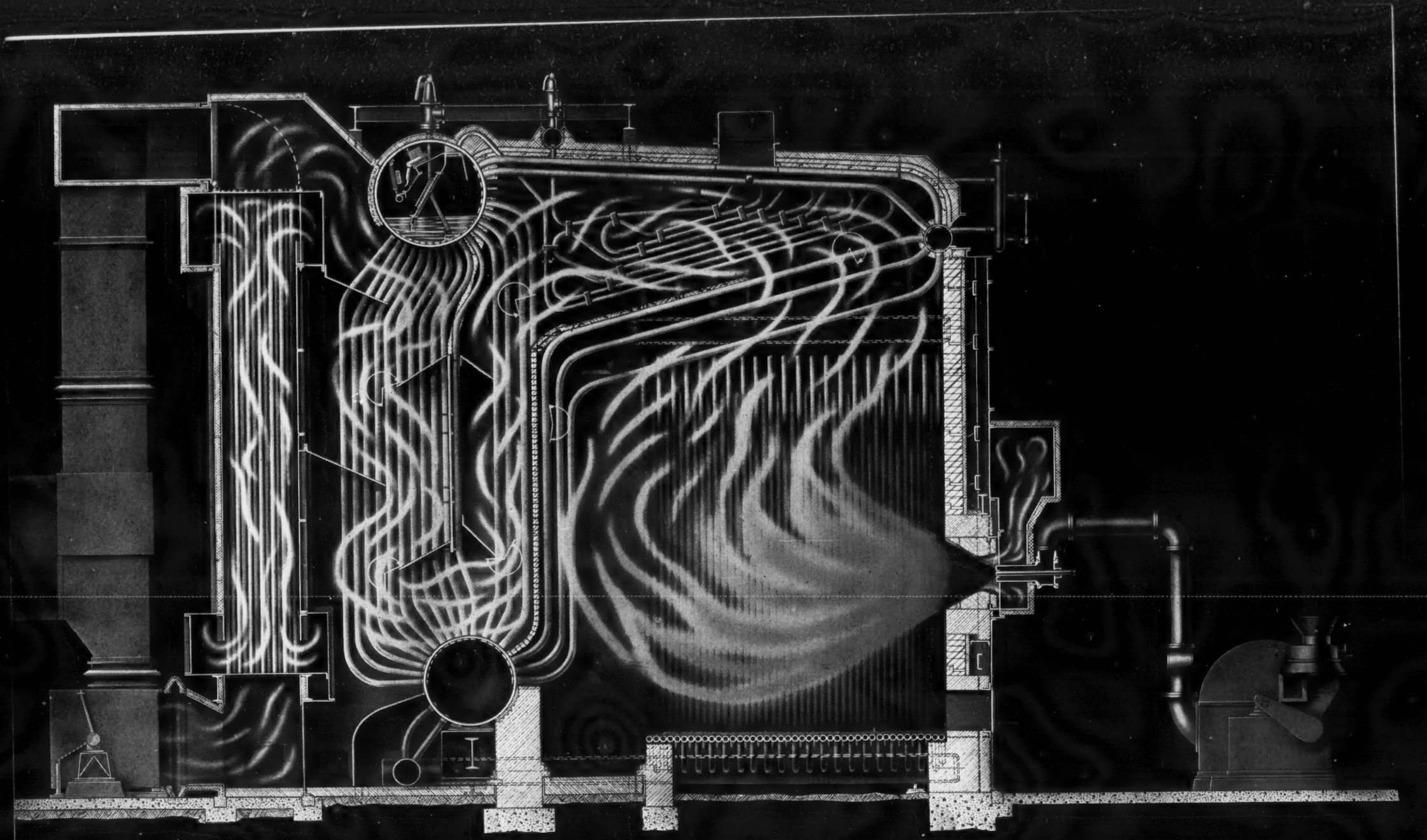
. . . tailored pipe joints

particularly call your attention to "Industrial Tops" (page 126), "Tailored Pipe Joints" (*exactly how* to shape pipe ends and openings for welding, page 142), "Kettering Talks on Diesels" (an interview with an outstanding engineer, page 132), "So You Want to be an Engineer" (page 154). . . . The last mentioned is somewhat out of our usual line, designed to meet a special situation. We found that a lot of our readers had sons, nephews or young friends who wanted to train themselves for success in engineering and didn't know how to go about it. . . . The advice on page 154 was first prepared for a specific young man standing at that turning point. Its author knows both the college end and the practical aftermath, and proceeds to hand out the straight dope as he sees it. . . . We figure that this advice will be dollars-in-the-pocket for a lot of ambitious young men, if their older engineer friends among *Power's* readers will route it their way.

PHIL SWAIN, Editor

Colorado Colosseum

Modern power construction brings back the atmosphere of an ancient Roman amphitheatre as Parker Dam, a U S Bureau of Reclamation project, grows rapidly in a narrow canyon 15 miles north of Parker, Ariz. Rising from the world's deepest foundation excavation, 225 ft below the normal bed of the Colorado River, the concrete-arch dam will climb to a total height of 340 ft. Water impounded by Parker Dam will serve the Metropolitan Water District of Southern California and also provide head for a 100,000-hp power plant to be built later. Swinging down from a cableway, in the center of the photograph, is the 8-cu yd concrete bucket used in constructing the dam. The spillway structure at the upper left indicates how far the completed dam will rise up the canyon wall

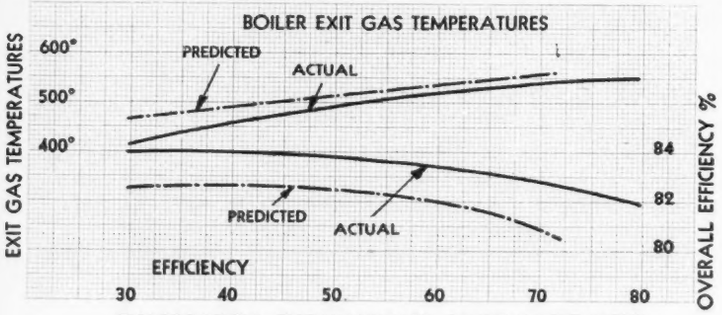


THE NEW RILEY TYPE "RP" BOILER UNIT

A Unit that promised GREAT PERFORMANCE

A Unit that promised GREAT PERFORMANCE *and* FAITHFULLY FULFILLED *the promise.*

Because of the many distinctive design characteristics, Riley "RP" Boiler Units held out from the start the promise of excellent performance results with lower initial investment costs. The first "RP" unit to be placed in service, as well as each succeeding unit, has faithfully fulfilled this promise—producing results invariably in excess of guaranteed performance.



Performance Riley "RP" Unit—Lewiston Bleachery

Take, for instance, the Riley "RP" boiler unit at Lewiston Bleachery—a unit with a maximum guaranteed capacity of 72,000 pounds of steam per hour, pulverized coal fired with neither air heater nor other heat recovery equipment. This unit is operating at efficiencies between 84 and 82.7% within the load range guaranteed in spite of an extremely fluctuating bleachery plant load. Performance that means saving of from 13 to 17 tons of coal per day over former stoker fired units. Similar excellent results are being obtained from other Riley "RP" Units.

The enthusiastic reports coming from owners and operators of Riley "RP" Boilers is evidence of the correctness of fundamental principles behind the design. Such reports of satisfactory gratifying performance of existing installations verified by prospective purchasers has brought about a rapidly growing preference for—a decided swing towards Riley "RP" Boiler Units. Riley "RP" Boilers are being selected and installed in ever increasing numbers.

In justice to yourself and your company, you should thoroughly investigate Riley "RP" Boiler Units for steam capacities from 30,000 to 150,000 pounds of steam per hour. Riley engineers are always glad to be of service to you in solving steam generating and fuel burning problems.

The Rapidly Growing List of Riley "RP" Boiler Units

Guide Lamp Co., Anderson, Ind.
1 – 50,000 lbs./hr., 275 lbs., 577° F., Pulverized Coal
Bemis Bros. Bag Co., Peoria, Ill.
1 – 70,000 lbs./hr., 275 lbs., 600° F., Pulverized Coal
Wheeling Steel Co., Portsmouth, Ohio
1 – 100,000 lbs./hr., 660 lbs., 650° F., Pulverized Coal
Newport Elec. Corp., Newport, R. I.
2 – 60,000 lbs./hr., 475 lbs., 756° F., Oil
General Aniline Co., Rensselaer, N. Y.
1 – 80,000 lbs./hr., 250 lbs., 475° F., Pulverized Coal
Riverside Metal Co., Riverside, N. J.
1 – 65,000 lbs./hr., 450 lbs., 516° F., Pulverized Coal
Central Ohio Pr. & Lt. Co., Findlay, Ohio
2 – 60,000 lbs./hr., 450 lbs., 825° F., Pulverized Coal
Hartford City Paper Co., Hartford City, Ind.
1 – 55,000 lbs./hr., 350 lbs., 600° F., Pulverized Coal
Lewiston Bleachery, Lewiston, Me.
1 – 70,000 lbs./hr., 450 lbs., 660° F., Pulverized Coal
Hellwig Silk Dyeing Co., Philadelphia, Pa.
1 – 100,000 lbs./hr., 475 lbs., 145 lbs., Oper.
Natrona Pr. & Lt. Co., Natrona, Pa.
1 – 90,000 lbs./hr., 450 lbs., 700° F.
Great Lakes Steel Co., Detroit, Mich.
2 – 100,000 lbs./hr., 450 lbs., 700° F., Coke and Furnace Gas
S. J. Brisban Co., South America
1 – 36,000 lbs./hr., 425 lbs., 650° F., Pulverized Coal
Winchester Repeating Arms, New Haven, Conn.
2 – 75,000 lbs./hr., 725 lbs., 750° F., Pulverized Coal
Western Cartridge Co., E. Alton, Ill.
2 – 75,000 lbs./hr., 725 lbs., 750° F., Pulverized Coal
American Bridge, Trenton, N. J.
2 – 35,000 lbs./hr., 275 lbs., Jones Stoker
Port Huron Sulphite & Paper Co., Port Huron, Mich.
1 – 80,000 lbs./hr., 675 lbs., 710° F., Pulverized Coal
Barrett Co., Philadelphia, Pa.
1 – 80,000 lbs./hr., 450 lbs., 500° F., Present Oil
Humble Oil & Ref. Co., Ingleside, Texas
1 – 40,000 lbs./hr., 400 lbs., 640° F., Oil
Yazoo Municipal Plant, Yazoo, Miss.
1 – 60,000 lbs./hr., 275 lbs., 632° F., Gas
Suchar Process Corp., Yonkers, N. Y.
1 – 60,000 lbs./hr., 250 lbs., 455° F., Pulverized Coal
Northern Paper Mills, Green Bay, Wis.
2 – 75,000 lbs./hr., 700 lbs., 700° F., Pulverized Coal

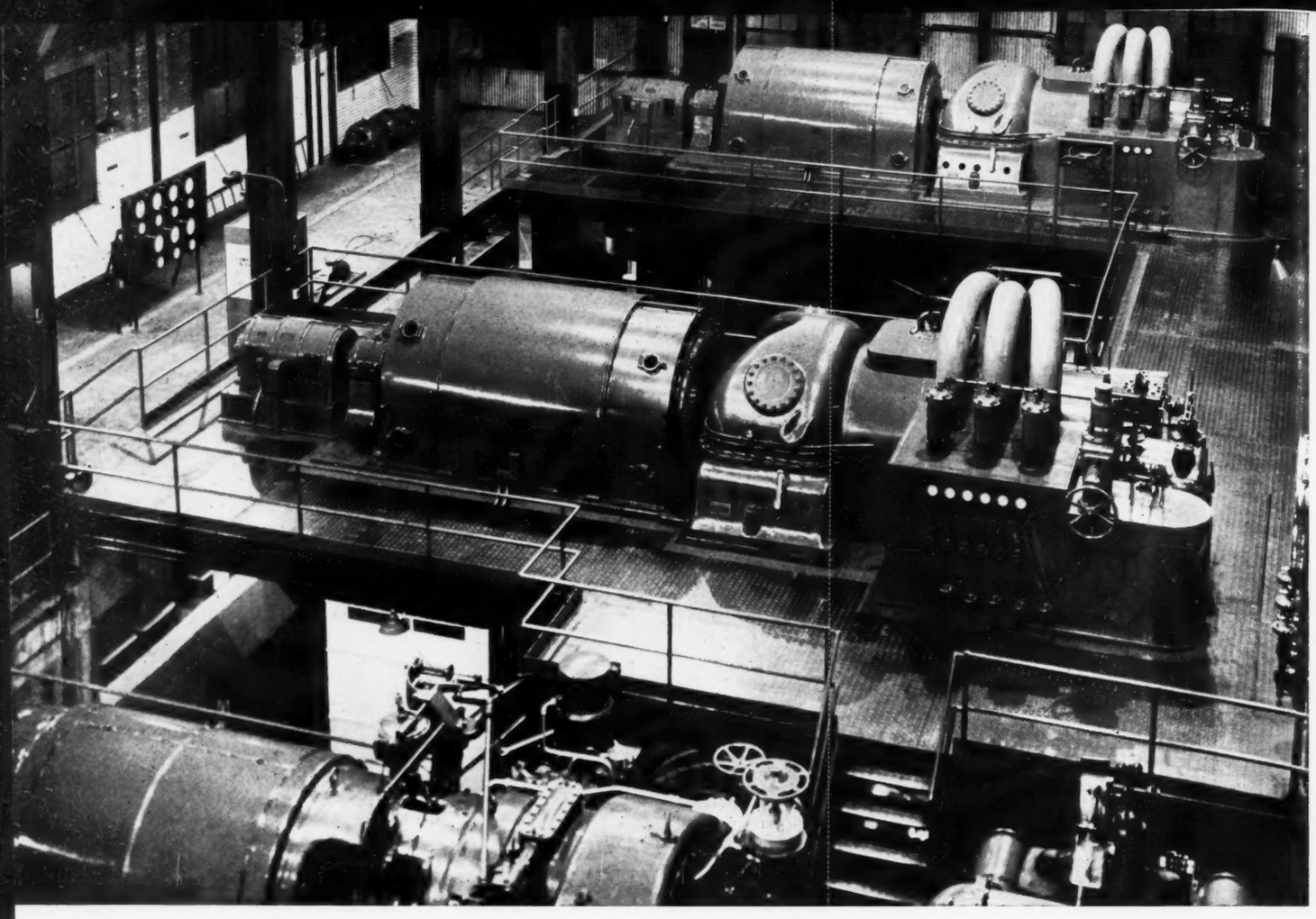
RILEY

STOKER CORPORATION
WORCESTER, MASSACHUSETTS

COMPLETE STEAM GENERATING UNITS

BOILERS - SUPERHEATERS - AIR HEATERS - ECONOMIZERS
PULVERIZERS - BURNERS - STOKERS - WATER-COOLED FURNACES
STEEL-CLAD SETTINGS

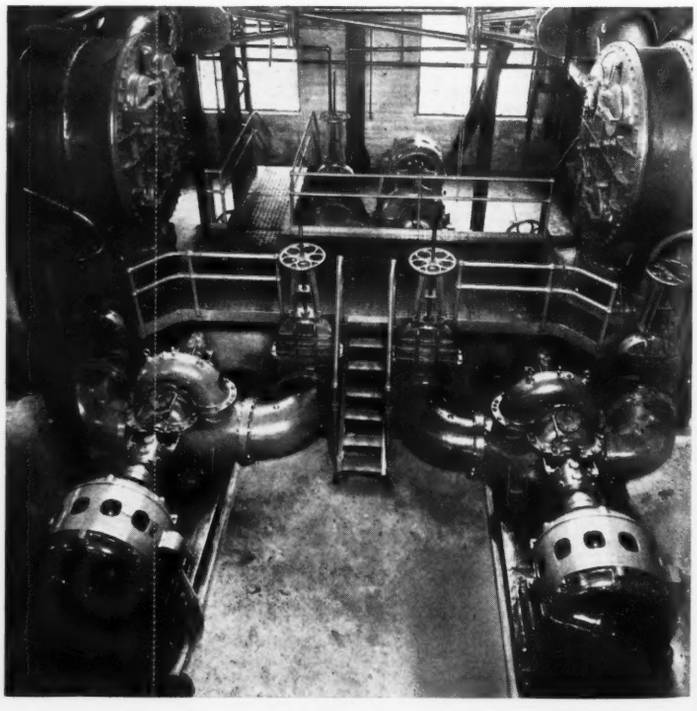
Boston New York Philadelphia Pittsburgh Buffalo Cleveland Detroit Tacoma Baltimore Milwaukee Denver
St. Louis Cincinnati Houston Chicago St. Paul Kansas City Los Angeles Atlanta Memphis New Orleans



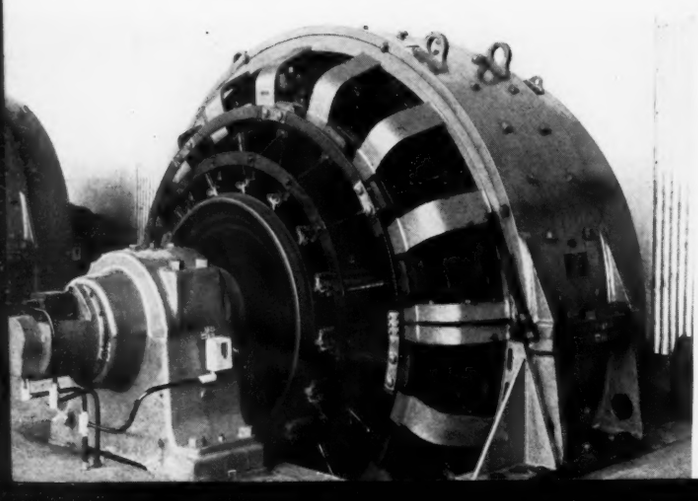
Two 7500-kw, automatic-extraction, condensing turbines drive 9375-kva, 6600-volt, 60-cycle alternators at 3600 rpm

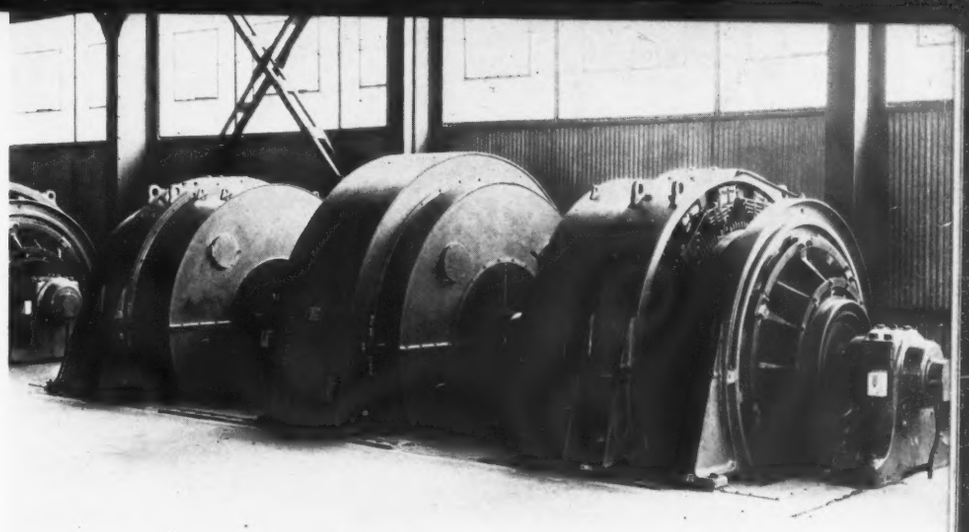
Steam Serves Steel

Two 8000-sq ft steel-shell surface condensers are served by three 11,300-gpm circulating pumps, each driven by a 150-hp motor



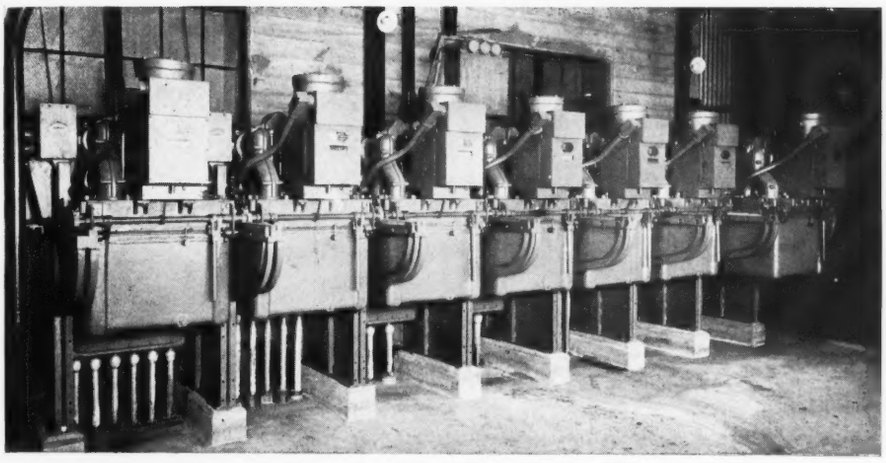
One of three 3500-hp, 600-volt, 175- to 350-rpm motors that drive hot-strip finishing mill





One of two 5000-kw, synchronous - motor - driven, dc generator sets that supply hot-strip finishing-mill motors

(All photos courtesy Allis-Chalmers Mfg Co.)

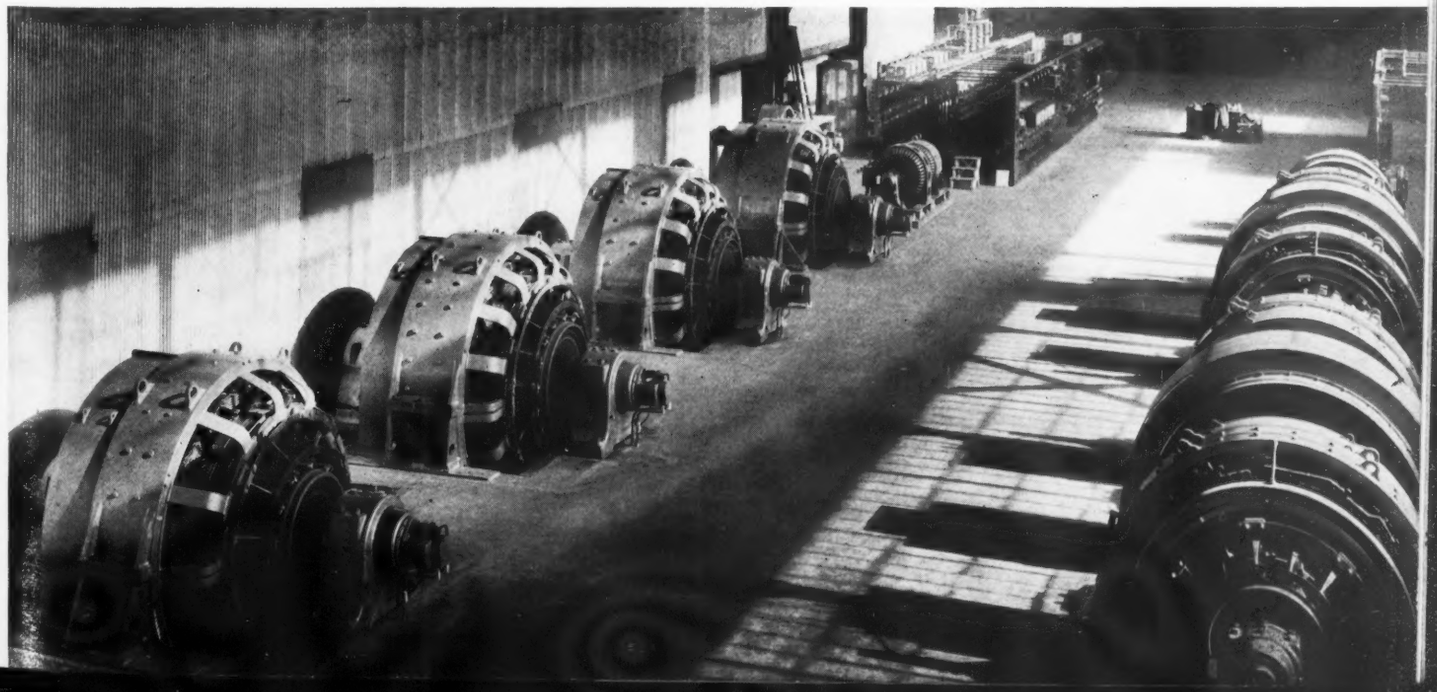


Metal - clad switchgear in power house for 6600-volt service

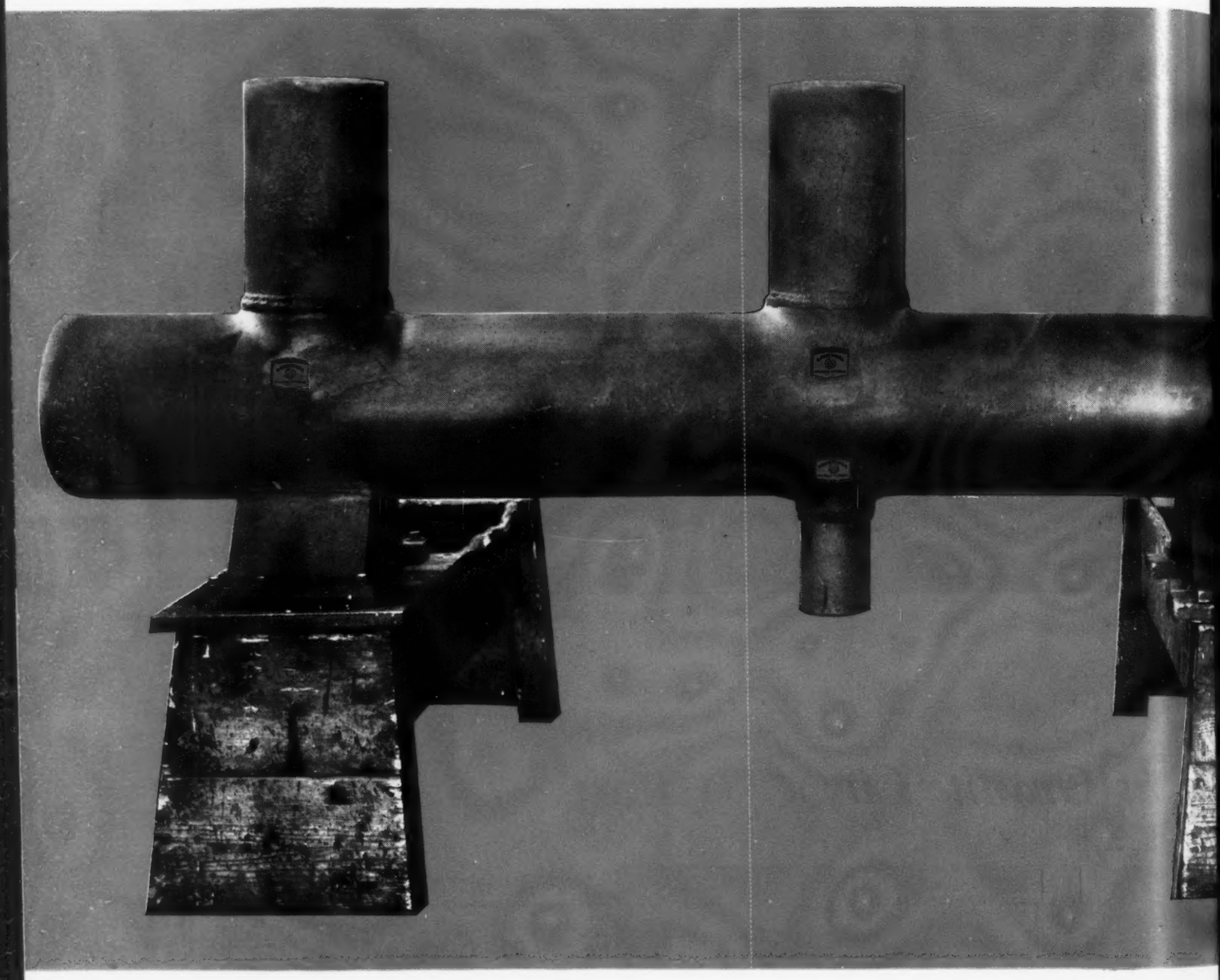
at Granite City

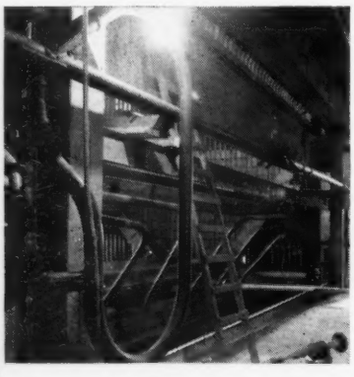
New plant of Granite City Steel Co, Granite City, Ill., supplies power-generating steam at 436 lb per sq in. and 640 F

Motor room showing main roll-drive motors (left) and main hot-strip-mill motor-generator sets

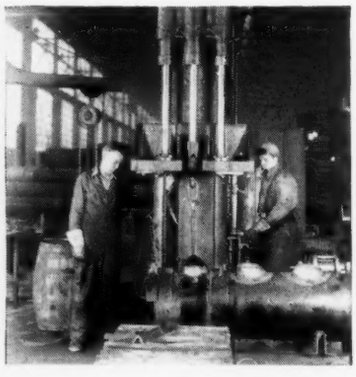


It Takes Interpretation . . .



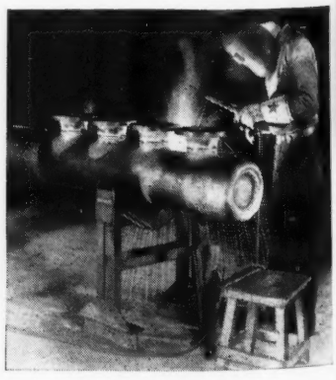


COMPLICATED BENDS like that shown above present no problems to Grinnell. Angles are kept accurate to a degree, inside and outside contours are clean and smooth.



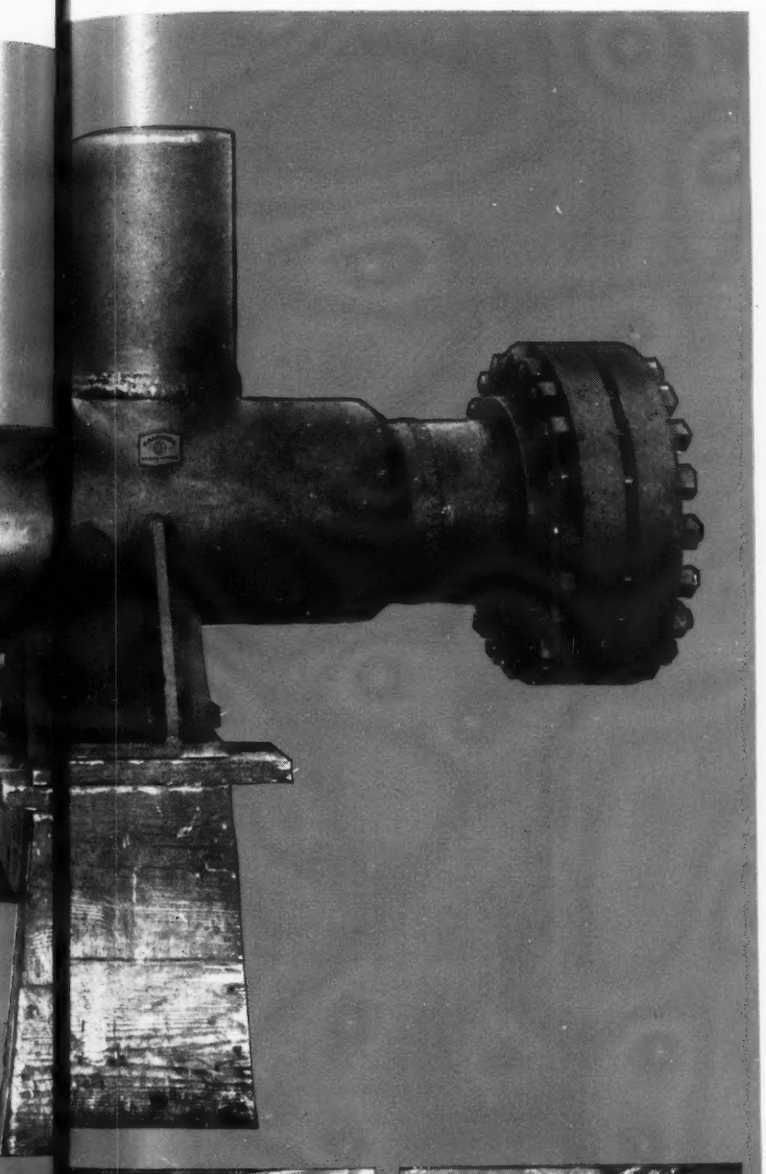
THOUSANDS OF DOLLARS invested in these hydraulic machines so that outlets can be extruded, and only plain circumferential butt welds will be required.

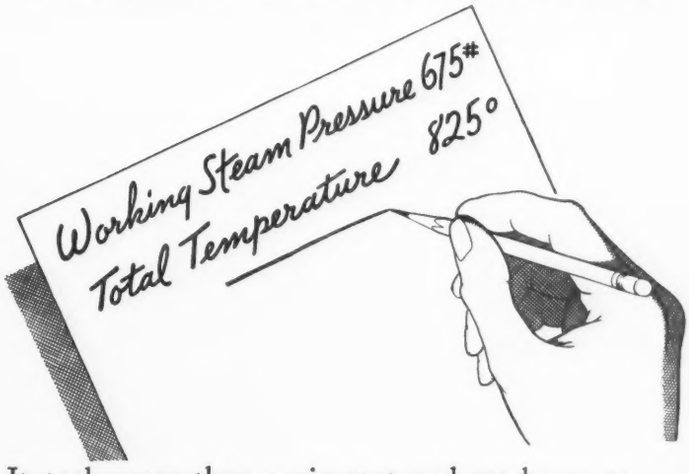
HIGH PRESSURE electric plants, paper mills, tire and rubber manufacturers, mining operations, automobile manufacturers, oil refineries, pulverized coal conveyors are among industries specifying Grinnell Prefabrication.



THE A.S.A. CODE for Pressure Piping is strict, but Grinnell Welders are qualified under it . . . Grinnell installations are pretested to qualify readily for insurance.

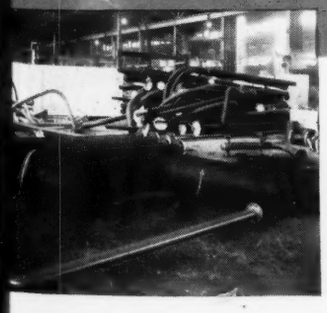
. TO MAKE IDEAS AND PLANS INTO PIPING

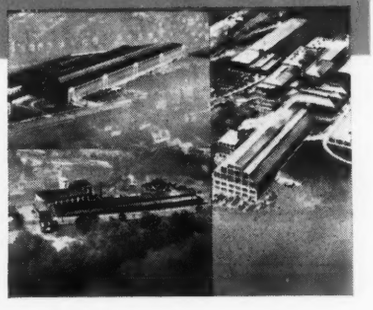




It took more than equipment and workmen to transform the specifications for this high-temperature, high-pressure header into a finished prefabricated unit. . . . Ideas, plans and figures of engineers were *interpreted* in terms of the newest and best materials and processes available * * Thus *material strength* was interpreted as a turned and bored forged tube with integral head . . . *structural strength* and *smooth contours* in terms of Grinnell hydraulically extruded outlets, with integral reinforcement, and circumferential butt welds only.

It is this interpretation at the crucial point of a prefabrication job that has made Grinnell prefabrication stand for economy in cost and labor, easier erection, and trouble-free performance. Learn the true economy of prefabrication by calling in Grinnell while your next piping job is still on paper. Grinnell Co., Inc., Executive Offices, Providence, R. I. Branch offices in principal cities.





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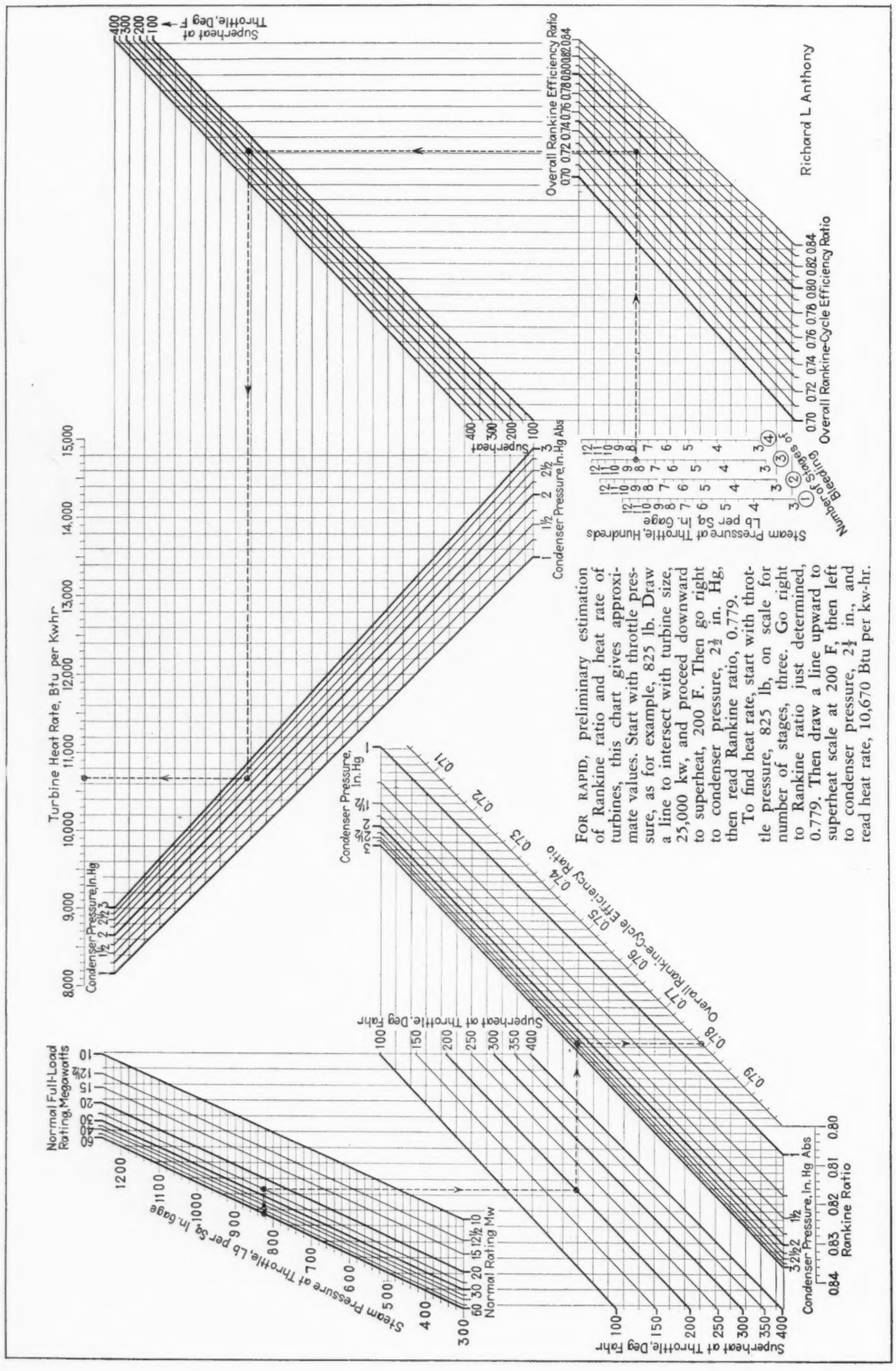
Number 67

Estimating Turbine Performance


Richard L Anthony
Turbine Heat Rate, Btu per Kwhr.
Condenser Pressure, In. Hg
Superheat at Throttle, Deg F
Overall Rankine Efficiency Ratio
Overall Rankine-Cycle Efficiency Ratio
Steam Pressure at Throttle, Hundreds Lb per Sq In. Gage
Number of Bleedings
Normal Full-Load Rating, Megawatts
Normal Rating Mw
Condenser Pressure, In. Hg Abs
Rankine Ratio

FOR RAPID, preliminary estimation of Rankine ratio and heat rate of turbines, this chart gives approximate values. Start with throttle pressure, as for example, 825 lb. Draw a line to intersect with turbine size, 25,000 kw, and proceed downward to superheat, 200 F. Then go right to condenser pressure, 2½ in. Hg, then read Rankine ratio, 0.779.

To find heat rate, start with throttle pressure, 825 lb, on scale for number of stages, three. Go right to Rankine ratio just determined, 0.779. Then draw a line upward to superheat scale at 200 F; then left to condenser pressure, 2½ in., and read heat rate, 10,670 Btu per kw-hr.

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What Does Power Cost?

In a power-cost symposium at the annual meeting of the ASCE, C F Hirshfeld and R M Van Duzer, Jr reported average costs of steam and diesel-generated power

NOBODY CAN SAY what the cost of power really is, as Mr. Van Duzer pointed out at the beginning of his paper. With a warning that the cost of power is as flexible an expression as the cost of apples, he defined it as "total cost to the producer at the point of generation and ready for delivery to the transmission system". The cost of power thus defined may legitimately represent either a very large part or a very small part of the cost to the ultimate consumer, depending on expenditures for transmission, distribution, metering, etc.

Central Stations

Limiting the discussion to central-station steam-turbine plants, the authors stated that average costs are a composite of many plants of varying ages. One range of values is therefore given for lower cost plants and another for higher cost plants.

Assuming coal at $4.00 per ton, figures for nominal 225-lb, 650-F plants are given in Fig. 1. Curves (e) show fuel component, (f) include operating labor at an arbitrary 70 c per man hour. Maintenance labor and material, included in curves (g), vary widely from plant to plant, as do certain other minor charges for water, supplies, clerical and miscellaneous.

An extended explanation of the items of fixed cost in curves (h) indicates the difficulty of arriving at a fair average plant cost and the danger in reporting figures in which a wide variation is not only possible but usual. A unit investment of $100 per kilowatt and a fixed-charge rate of 12% have been used in Fig. 1. Curves (i) include a variable amount of general overhead to call attention to the need for such a factor in a going concern rather than to state an exact value.

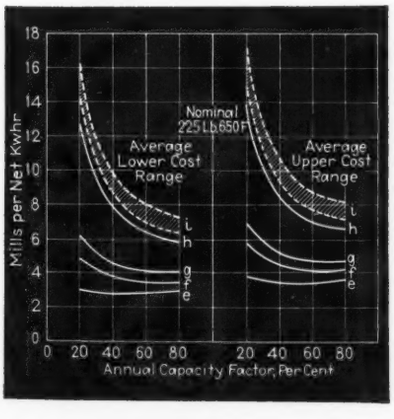


Fig. 1—Average upper and lower ranges of power cost, nominal 225-lb, 650-F steam plant

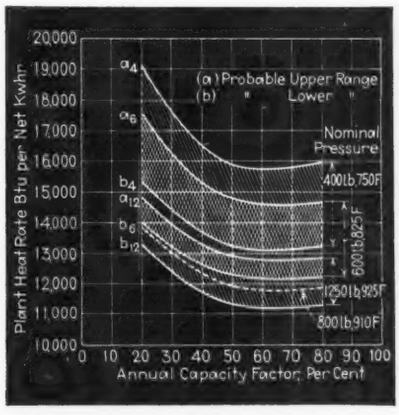

Plant Heat Rate Btu per Net Kwhr
(a) Probable Upper Range
(b) " Lower "
Nominal Pressure
400 Lb 750 F
600 Lb 825 F
1250 Lb 925 F
800 Lb 910 F
Annual Capacity Factor, Per Cent

Fig. 2—Thermal performance, steam plant, range 400- to 1250-lb nominal pressure

Theoretically, higher pressure plants should cost more to build, but actually, varying commodity prices and developments in plant equipment have made high-pressure plants cost little if any more than older low-pressure plants. In face of this situation, a constant $100 per kilowatt regardless of pressure has been assumed as a ready means of presenting figures that can be corrected easily to any set of specific conditions.

The range of thermal performance achieved in practice, however, was taken from the experience of many plants, Fig. 2. Only in the case of 800-lb stations was insufficient operating experience available; this curve has been interpolated between 600-lb and 1200-lb plant performance.

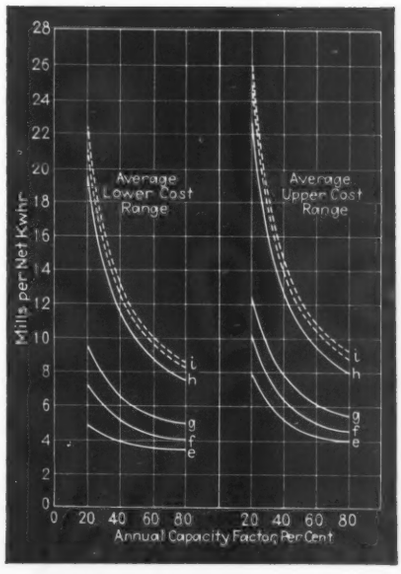


Fig. 3—Average upper and lower ranges of power cost for diesel plants

Speculating on future steam-plant developments, the authors referred to present annual performance of 11,000 Btu per net kw-hr. With increases in pressure and temperature even now technically possible, designing engineers envisage 10,000 Btu per net kw-hr.

Diesels

Internal-combustion-engine plants are restricted to comparatively small size per prime mover. Power cost data for diesel plants have been arranged to parallel analysis for steam plants so that the two types are more nearly comparable. Comparison with commonly quoted diesel-plant performance figures is not possible from the curves of Fig. 3 without recalculation of the data in accordance with the more usual allocation of charges.

With full knowledge that man is, in general, a poor prophet, Messrs. Hirshfeld and Van Duzer reasoned that major advances will continue to be made in the face of potential economic loss and that the "chances for continued reduction of total power cost at the fuel-burning generating plant are indeed very large."

Two-Speed Motors Suit Rotary

Positive rotary blowers driven by 2-speed synchronous motors give a flexible range of volumes without sacrificing desirable temperature and pressure characteristics

By DONALD DOWLING*
and FRANK SVATOS†

EACH GALLON of sewage treated by activated-sludge process requires, depending on the character of the sewage, from 0.5 to 1 cu ft of air. This represents a considerable power requirement. For instance, the Wards Island plant in New York, N. Y., serving portions of Manhattan and the Bronx, will handle 180,000,000 gal. of sewage a day with an installed blower capacity of 12,000 hp; proposed Tallman's Island plant, New York, N. Y., 40,000,000 gal. per day, 2100 hp; Providence, R. I. plant, already completed, 35,000,000 gal. per day, 1200 hp.

Blowers to meet the service requirements of aerating activated-sludge must operate under wide variations of inlet temperature, often as much as from minus 20 to 212 F. Required air pressure may vary as much as 1.5 lb, due to changes in diffuser-tile resistance. Since changes in air temperature and air pressure have an effect on the pressure, volume and power characteristics of blowers, the range of operating conditions must be considered in designing the blower.

Sewage flow is not constant and it is important that air flow be matched with sewage flow to avoid waste of power. Most plants use a multiplicity of units for major volume control. Beyond this, variable capacity may be obtained by throttling or speed control. Speed control or its equivalent provides most economical operation.

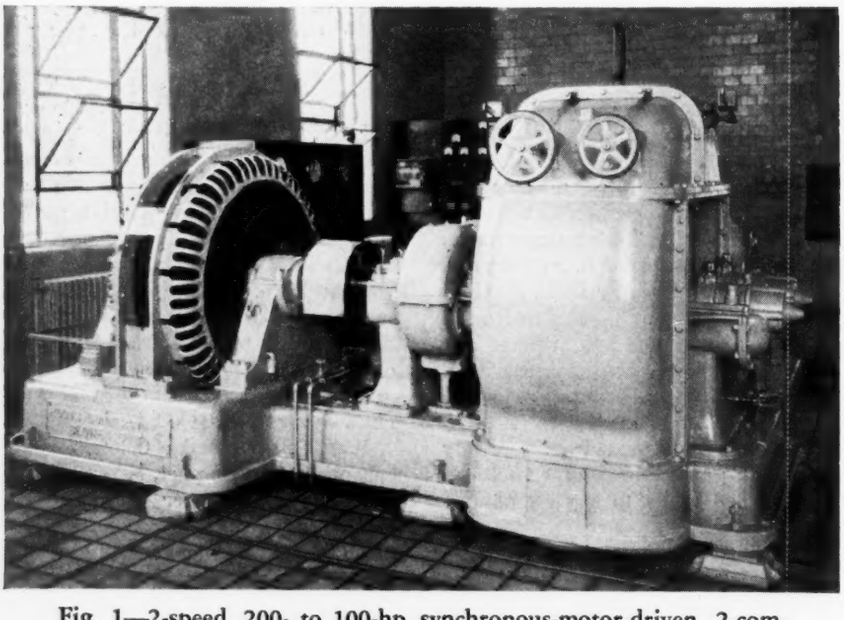


Fig. 1—2-speed, 200- to 100-hp synchronous-motor-driven, 2-compartment positive-pressure blower at Lancaster, Pa.

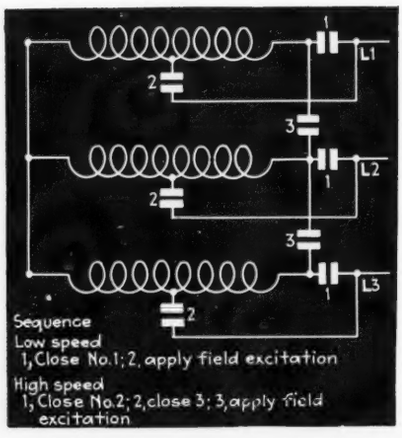


Fig. 3—Schematic diagram of stator-control connections for 2-speed synchronous motor

Air pressure required is usually 7.5 lb per sq in. from turbo-centrifugal or rotary positive blowers. Centrifugal blowers are driven at constant speed either through speed-increasing gears by moderate speed motors or by direct connection to 3,600-rpm synchronous or squirrel-cage motors. They represent no special electrical problems beyond those encountered in the design of large motors for high speed. Rotary positive blowers, in sizes from 5000 to 20,000-cfm, operate normally at about 600 to 300 rpm. These speeds are ideal for direct-connected synchronous-motor drive.

At Lancaster, Pa. and Providence, R. I., blower capacity variation was partially accomplished by installing 2-speed synchronous motors driving rotary positive blowers. In such installations, flexible range of volumes permits matching air flow with sewage flow without sacrificing desirable temperature and pressure.

At Lancaster, there are two independent sewage-disposal plants of equal size, and in each a 200- to 100-hp, 4850-cfm blower provides enough air for the entire plant requirement. The blower, unusual in design, has two impeller compartments of approxi-

* Roots-Connersville Blower Corp

† Industrial Div, Westinghouse Electric & Mfg Co

Blowers

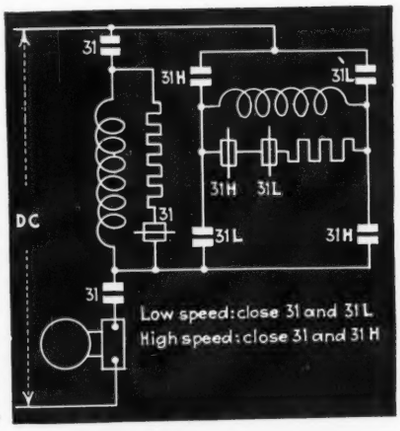


Fig. 4—Schematic diagram of field-winding connections for 2-speed synchronous motor

mately one-third and two-thirds capacity. The compartment can be used separately or together. With a 2-speed motor operating at 300 rpm on low speed and 600 rpm on high speed, there result six different air volumes with kilowatt consumption directly in proportion to the volume delivered.

At Providence, three single-compartment blowers are installed. Each has 400- to 200-hp, 400- to 200-rpm motors, with two capacities for each blower, 13,000 and 6000 cfm. This affords a total of six air capacities for the entire plant, with kilowatt consumption in proportion.

It might be suggested that multi-speed squirrel-cage motors could be used, but they have the disadvantage of low power factor on low speed. The 2-speed synchronous motors at Providence and Lancaster have unity power factor and high efficiency at each speed. Speed change is obtained by grouping the poles so that on high speed, two adjacent poles have the same polarity and on low speed, alternate poles have the same polarity. A series-parallel stator-winding start connection is used, Fig. 3. At Lancaster, a motor-generator set provides excitation, and at Providence, the exciters are direct connected, exciting at 250 volts on high speed and 125 volts on low speed.

In both of these plants, control is completely automatic by a pushbutton station marked "stop," "slow," and "fast." At Lancaster, the motors start across-the-line on low speed as squirrel-cage motors and are thrown into synchronism by a time device. When high speed is required, they start on low speed first, then go on part winding of high speed, and finally on full winding. This limits the starting current to a practical quantity.

At Providence, the current is supplied from the nearby city-operated garbage incinerator, where the by-product steam produced operates a 1200-kva turbine-generator. The practical starting current for each blower is limited to 480 kva. In order to remain within this limitation, after starting across-the-line on low speed, the motors are switched to high speed by means of auto-transformer reduced voltage. That efficiencies are good through the entire operating range is shown by Tables I and II compiled from acceptance tests.

TABLE I—PERFORMANCE OF 28x32.5-IN. BLOWER WITH 400- TO 200-HP, 400- TO 200-RPM SYNCHRONOUS MOTOR; IN PROVIDENCE, R. I. SEWAGE PLANT

	200			400		
Speed rpm:						
Pressure lb per sq in	5	6	7	5	6	7
Capacity, cfm	6,200	6,100	6,000	13,200	13,100	13,000
bhp	150	180	212	318	377	433
Blower efficiency, %, single-stage adabatic	81	78	73.5	81.5	80	78
Power, kw	127	150	176	255	302	346
Motor efficiency, %, including all losses	88.2	89.3	89.8	93.0	93.2	93.5
Over-all efficiency, %	71.5	69.7	66.0	75.5	74.5	74

TABLE II—PERFORMANCE OF 20x4.25x11.75-IN. 2-COMPARTMENT BLOWER WITH 200- TO 100-HP, 600- to 300-RPM SYNCHRONOUS MOTOR IN LANCASTER, PA. SEWAGE PLANT

	300			600		
Speed, rpm:						
Pressure, lb per sq in	7.5	7.5	75.	7.5	7.5	7.5
Blower compartment No.	1	2	1 & 2	1	2	1 & 2
Capacity, cfm	640	1,590	2,230	1,285	3,570	4,855
bhp	27	66	88	50	139	182
Blower efficiency, %, single-stage adiabatic	67	68	71.5	72.5	72.5	75
Power, kw	25	55	73	45	113	147
Motor efficiency, %, including all losses	82	90	90	83	91.6	92.5
Over-all efficiency, %	55	61	66	60	66.5	69.5

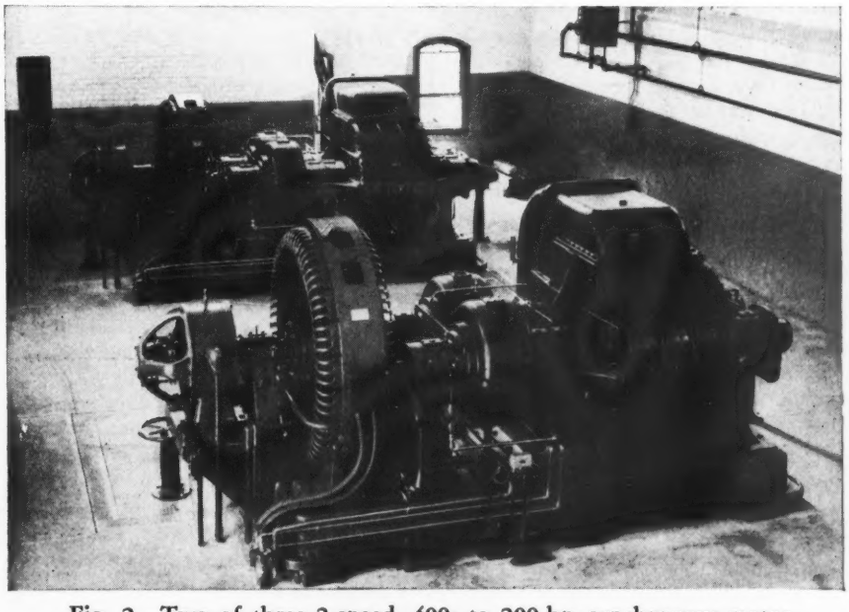


Fig. 2—Two of three 2-speed, 400- to 200-hp synchronous-motor-driven positive blowers in Providence, R. I., sewage-disposal plant

Air Conditioning in the Limelight

Heating and refrigerating engineers meet in New York; over 300 manufacturers exhibit at Air-Conditioning Exposition

JANUARY 24-28 was air-conditioning week for New York. The American Society of Heating & Ventilating Engineers, the American Society of Refrigerating Engineers, and the National Warm Air Heating and Air Conditioning Association all held annual meetings. In addition, the 5th International Heating & Ventilating Exposition (over 300 exhibitors) held the attention of both members of visitors during the entire week.

The ASHVE opened its meeting in a cheerful frame of mind, reporting that the organization has now over 3000 members, an all-time high. The first technical paper, "Application and Economy of Steam-Jet Refrigeration," by A R Mumford and A A Markson, New York Steam Corp research engineers, pointed out economical applications of this type of refrigeration, particularly if steam reheat is used. The authors were frank in admitting that advantages would accrue to central-station steam companies from a better yearly load curve, but that economies to the user justified consideration of steam-jet refrigeration (See Fig. 1).

"Cooling-Tower Equipment and Its Relation to Water Conservation," by S I Rottmayer, mechanical engineer, staff of Samuel R Lewis, Chicago consulting engineer, described various types of cooling towers and evaporative condensers, and considered efficiencies, operating costs, etc. The author, discussing the central business district of Chicago, said "the facilities for supplying water are adequate to serve all estimated demands for the next 10 years. The cost of water, 51 cents per 1000 cu ft, is lowest of any city on which there is available information. The sewer facilities in much of this district, however, are hopelessly inadequate and there are no prospects for their improvement. This situation, therefore, requires that any air-conditioning refrigerating plant, if it is to be capable of operating whenever required, shall have its own water-cooling equipment."

In a joint session with the National Warm Air Assn, Prof A P Kratz, Mechanical Engrg Dept, University of Illinois, described standards set up for warm-air heating and experiments carried on at the U of I research residence. D W Nelson, assistant professor of steam and gas engineering, University of Wisconsin, and D J Stewart, Mgr Electrical Div, Barber-Coleman Co, in a paper "Air Distribution of Side-Wall Outlets," called attention to the need for an authoritative set of requirements to determine comfortable conditions within a cooled space. Tests conducted by the authors indicated that a plain side-wall opening is unsatisfactory.

Experiments conducted by T S Carswell, H K Nason and J D Fleming, Monsanto Chemical Co, reported in a paper "Studies on Bacterial Control in Air Conditioning" led to the conclusion that an air washer operated on sterile water is an efficient apparatus for bacterial control of air and that use of a suitable germicide is a convenient way to insure sterility of washing water. Any germicide used in air-conditioning work should be highly potent against micro-organism involved, non-corrosive to metal equipment, odorless in effective concentration, non-volatile, non-toxic to humans, economical and safe, stable on prolonged aeration, and easily dissolved in water. In their tests, the authors used a commercial mixture of ortho- and parabenzyl phenols.

In a joint session with the ASRE, all-asbestos duct, a new development, was described by R H Heilman, Mellon Institute of Industrial Research, and R A MacArthus, Philip Carey Mfg Co. These ducts consists of a stiff inner shell, over which an insulating outer shell makes a sliding fit. Lengths are assembled so that inner and outer shell joints are staggered, making the duct self-supporting. Tests show that air friction is about the same as for metal ducts, and that the thermal conductivity is between that of bare-metal ducts and metal ducts with insulation. The asbestos duct is superior acoustically (see Fig. 2).

Fundamental data on the relation between air conditions and comfort and health were presented in two research papers. The first, by C E A Winslow, L P Herrington, and A P Gagge, reported tests made at the John B Pierce Laboratory, with unclothed subjects in a semi-reclining position. The analysis shows the thermal processes taking place as the body adapts itself to surrounding air.

Artificial Lighting

Effect of artificial lighting on air conditioning was described by Walter Sturrock, General Electric illuminating engineer. Tests conducted in the G E laboratories indicate that for interiors where high levels of illumination are used, separate ventilating systems may be used to carry off excess heat energy. This is of importance in northern latitudes for only 3 to 4 months each year; during the rest of the year this heat contributes to the building heating system.

"Summer Cooling Requirements of 275 Workers in an Air-Conditioned Office," a study conducted by A B Newton and R W Qualley, of Minneapolis-Honeywell Regulator Co, and F C Houghten and Carl Gutberlet, of the ASHVE research laboratory, concluded that about 72-deg effective temperature should be maintained throughout the cooling season in Minneapolis, with a drop to about 70 deg during May and June, and the last half of September.

The technical program of the 33rd Annual Meeting of the American Society of Refrigerating Engineers, held Jan. 25-27, included papers on practical engineering matters, on applications of refrigeration, and research reports.

Effect of low temperatures on metals, a little-known field, was explored in a paper by V T Malcolm, of the Chapman Valve Co. Experiments conducted by that company over the past 7 years indicate that brittleness is the biggest problem and that the notched-bar impact test is the best criterion of brittleness.

Tests have shown that non-ferrous alloys, either cast or rolled, are suit-

able for severe low-temperature service since they do not become brittle. Of the ferrous materials, alloys of the solid-solution type perform best at low temperatures, and experiment indicates that nickel, silicon and copper are the best alloying materials from this standpoint.

A comprehensive paper on air-conditioning controls was presented by S F Nicholl and W E Zieber of the York Ice Machinery Corp, at a joint meeting with the ASHVE. Controls as such were not considered; the paper showed how they are applied to different types of installations, and how to engineer such an application. Emphasis was laid on the importance of a complete engineering and economic analysis of each job. The first step, according to the authors, is to decide on how nearly automatic the operation is to be. The importance of knowing equipment limitations as they affect controls was pointed out by examples of cases where equipment characteristics made the controls useless over part of the range. Equally important is consideration of design as a whole.

Storage of refrigeration as a means of lowering power costs was considered by W F Friend of Ebasco Services Inc, who pointed out that power is usually the second largest item in the cost of operating an air-conditioning system, ranking next to fixed charges and amounting to about one-fifth of the total. The fact that air-conditioning load has an extremely low annual-load factor and contributes heavily to the peak, makes it impossible for the utilities to give it preferential rates. These factors also increase power costs where private generation is employed. Storage promises to even out the load curve, and permit less refrigerating equipment.

Absorption Refrigeration

The properties of aqua-ammonia solutions, used in absorption refrigeration, are now completely available, in English and in the customary engineering units, as a result of work done by Burgess H Jennings of Lehigh University and Francis P Shannon, Reading Coal and Iron Co. The tables presented in their paper give saturation temperature; total heat of saturated liquid aqua-ammonia and of saturated vapor, and the weight-percentage ammonia concentration of saturated vapor in equilibrium with saturated liquid.

Heat-transfer problems were considered in several papers. R H Swart, General Refrigeration Corp, discussed the development of analytical methods for calculating performance of finned-coil heating surfaces, and presented an interesting table showing the relationship between economic factors and design factors. Properties of low-temperature insulating materials, other than thermal conductivity, were measured by E R Queer and F G Hechler, of Penn State. Data on compressive strength and recovery, transverse strength, handleability, resistance to impact, dimensional uniformity, moisture absorption and capillarity, fire resistance, and settling of fill materials were presented. Tests on the heat transfer of brine coolers under varying operating conditions show that the principal factors are brine density, brine velocity, brine temperature, and logarithmic mean temperature difference, according to a paper by J C Consley, York Ice Machinery Corp.

The effect of dilution by a refrigerant on oil viscosity was discussed by O C Rutledge of the General Electric Co, who presented test data on various oils diluted with Freon, methyl formate, and sulphur dioxide. The answer to a question that has long puzzled designers, namely, what happens to capacity and other characteristics when the vapor entering the compressor is superheated, was supplied by L W Child of the Evans Products Co, who reported on tests of a compressor supplied with superheated vapor.

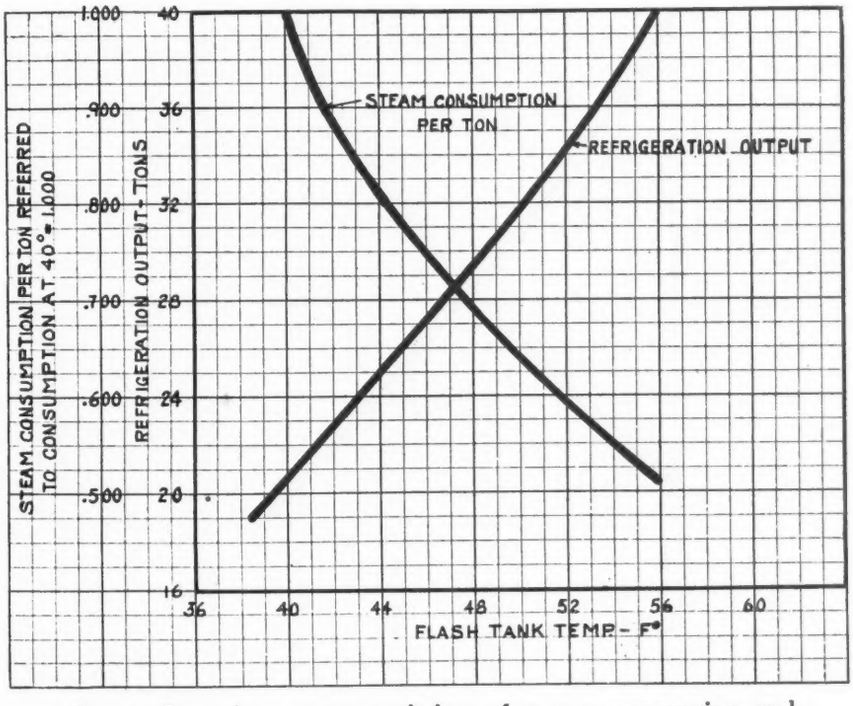


Fig. 1—Steam-jet system: variation of steam consumption and refrigeration output with flash-tank temperature

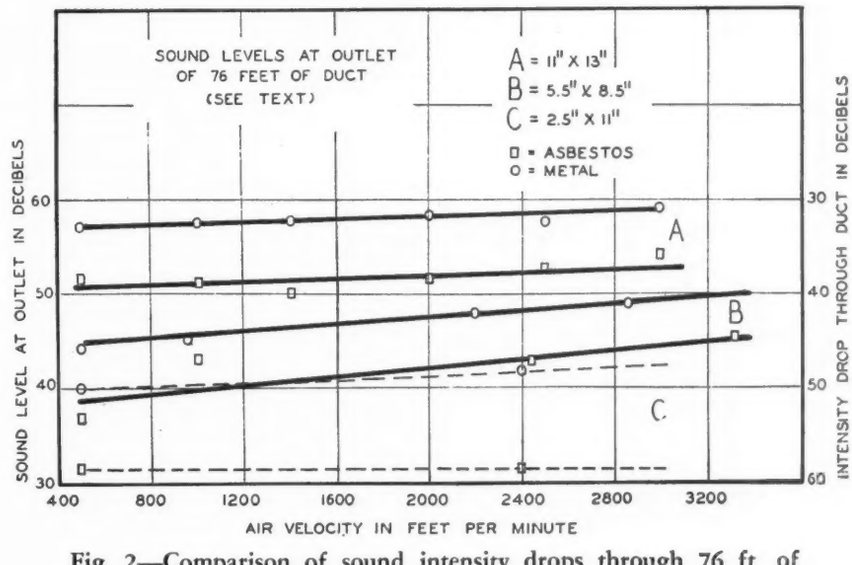


Fig. 2—Comparison of sound intensity drops through 76 ft of metal and asbestos ducts

Thyratrons Adjust AC-Motor Speed

A 400-hp motor, resembling a synchronous machine that operates as a series motor, takes its power supply through 18 thyratron tubes and has speed adjusted by grid control

THE SEARCH for an adjustable speed ac motor comparable to the dc shunt type has been long and not very successful. Consequently, when grid-controlled rectifiers were developed, attention was attracted to the possibility of providing the answer to the adjustable-speed problem. One of these developments has been installed in the Logan Station of the Appalachian Electric Power Co and put into operation May 29, 1936. Experience with this installation was presented in a paper at the American Institute of Electrical Engineers winter convention, held January 24 to 28 in New York, N. Y., by A H Beiler, electrical engineer of American Gas & Electric Co.

The motor is rated 400 hp, 2300 volts, 3-phase, 60-cycle, and was designed to drive an induced-draft fan having a speed range from 625 to 350 rpm. It closely resembles a standard synchronous motor with a rotating field, except that it has two independent star-connected stator windings installed in the same slots. Unlike a synchronous motor, however, the field terminals, after being brought out through the slip ring, connect to the neutral point of the star windings.

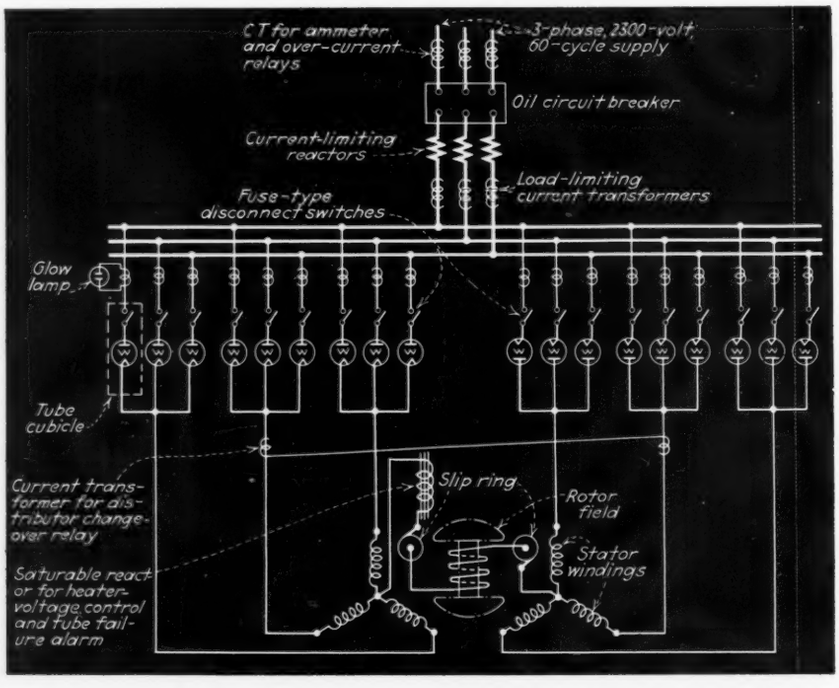


Diagram of power and motor connections for thyrathon-controlled draft fan motor at Appalachian Electric Power Co, Logan plant

As shown in the figure, the six remaining power leads connect in a special arrangement to a series of 18 thyratron tubes, each having a continuous rating of 12.5 amp, and a maximum rating of 75 amp.

The motor, although structurally resembling a synchronous machine, functions like a series motor and has characteristics closely resembling such a machine. The field winding and each phase of each stator winding are traversed by a direct current, although like values of current in the stator coils differ in time phase.

At first, a comparatively large number of minor difficulties arose. Yet, plant operators are enthusiastic about performance of the motor. Experience has shown them that no drive compares with it for ease of control, for smoothness of draft regulation, for ability to rotate at very low speed, and for almost entire elimination of fan-blade maintenance. This response seems convincing evidence of its success from a practical standpoint.

Thyratron Tubes

Most serious difficulty has been with the thyratron tubes. In 14 months, 22 failed, almost all of them due to the opening of the cathode-heater circuit. Actual hours of motor operation represent a service availability of 84%. This includes shutdowns from all causes, such as boiler and plant maintenance. Interruptions due to the motor alone took only 3.5% of operating time. An availability of 96.5% may be considered a satisfactory record for an entirely new type of control.

The thyratron tubes leave the biggest room for improvement. Without a doubt, the fragility of the cathode heaters can be corrected. The very persistency of this type of failure should be a clue to the remedial measures necessary. Steps have already been taken in this direction by the use of flexible instead of solid connections at the cathode-heater terminals within the tubes. Although defective tubes are replaced almost immediately during operation, it is interesting that no harmful effects occur if several tubes cease firing simultaneously.

Mr. Beiler arrives at the conclusion that whether the thyratron motor is here to stay would seem to depend to a considerable extent on the tube designer. The operating principles of the motor are fundamentally sound; the control will undoubtedly be improved and simplified. This should aid in reducing the first cost of the motor to a competitive level, but tubes must be made more rugged if maintenance costs are not to be excessive.

Readers' Problems

Questions *for Our Readers*

Slag Removal

Question 1

HAVE *any* POWER *readers had experience, successful or otherwise, with slag removal or slag prevention through use of proprietary slag removers or other compounds such as calcium chloride, molybdenum sulphide, etc? We intend doing something about our slagging problem, but would like to know what experience others have had before making a definite attack.*—TBS

Air-Conditioning Controls

Question 2

WE ARE *thinking of installing an air-conditioning system in a restaurant. We want to have it running by summer so have to move fast. What I want to know is how much control is actually needed for this job. In the preliminary plans, everything is controlled—tonnage, amount of bypass air, wet bulb and all the rest. The cost of control equipment to do all this is a fair sized share of the total cost. Isn't there some simple set of controls, even if they require some manual attention, that would keep us within the comfort zone without spending a lot of money and acquiring a complicated maintenance job, too? I would like to know if any* POWER *readers have had similar experience.*—FMA

Suitable answers from readers will be paid for if space is available for publication.

Copper Chloride For Soot Removal

Answers to January Question 1

The Question

I HAVE *been informed that copper chloride is used to clean soot from boilers and furnaces. I would like some information on this subject, particularly in connection with method of application and whether or not it has any harmful effect on the boiler. Also, is it copper chloride with or without water of crystallization?*—KG

Steam or Air Is Preferable

COPPER CHLORIDE has been used for cleaning soot from boilers; other chlorides, principally sodium and calcium chloride, have also been employed. There is one coal company that offers a can of soot remover with each ton of domestic coal furnished by them.

Since copper chloride has a lower decomposition temperature than some of the other chlorides, it does not require as hot a fire as sodium or calcium chloride. It should be used with water of crystallization, or enough added water so that the chloride can readily decompose into oxygen and hydrochloric acid.

The question of harmful effect on the boiler is subject to argument. Where sufficient soot is present to prevent the oxide or acid from coming in contact with the metal, there is probably no harmful effect. If an excess of chloride is used, there is bound to be action on any metallic surface available.

About the only information in literature available is, apparently, advertising matter put out by companies that furnish these chlorides for soot removal.

For boiler-soot removal, the better way seems to be by steam if there is 50 lb pressure or over, by compressed air if not. These are perhaps safer than chlorides.

Lakewood, Ohio J P SIMMONS

Cleaning Oil-Cooler Tubes

Answers to January Question 2

The Question

OUR *4000-kva turbines are fitted with oil coolers made up of a bank of tubes in a cylindrical casing. Water flows through the tubes, and oil is caused to cross the outside of the tubes many times by diaphragm baffles. The staggered layout of the tubes makes it impossible to obtain access to the inner tubes for cleaning, and in the course of time all but a narrow path in the center has become clogged. We have tried boiling a mixture of soda ash and trisodium phosphate in them for a fortnight, and other obvious schemes, but short of dismantling the tube stack (which is a sweated job) have not found a satisfactory solution.*—TDO

Try Reversing Flow

TDO DOES not state the nature of the material clogging the spaces between oil-cooler tubes, that is, whether it is asphaltic or parafinic. If the oil is distilled from a parafinic base—as are most of the Mid-Continent crudes—the deposit can probably be softened by filling the space with "mineral-seal" oil and heating, either by electric heaters, or by steam in the tubes. If the mineral-seal oil becomes turgid or badly discolored, drawing it off and replacing with new will probably complete the job.

Asphaltic-crude-base oils do not dissolve readily in mineral-seal oil or any of the lighter hydrocarbons such as kerosene or gasoline, since the material settling out is oxidized and is like the familiar paving asphalt. If asphaltic, the coating can be softened by a solution of hot brine or ordinary salt water, the salt softening the asphalt and disintegrating it so it can be flushed out with hot water.

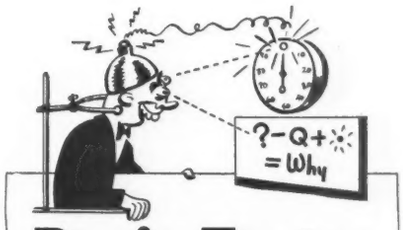
It may be possible to settle out much of the trouble-causing material by installing a settling tank into which the hot oil is run, oil for the turbine being drawn from this tank and passed through the cooler before being run into the machine.

Why not reverse flow and run the oil through the tubes and the water around them? Any water-borne substances causing scale or sludge could be removed by treatment, and the tubes could be cleaned on their inner, unimpeded surfaces by an approved type of tube cleaner. This last was the solution applied by the writer to a somewhat similar case in a refinery, where flow in a heat-exchanger bank was reversed to afford easier cleaning.

Longview, Texas M T PATE

Keep Steam On

OUR EXPERIENCE with cleaning oil-cooler tube bundles was much the same as that of TDO, up to a certain point. Repeated boiling in a steam bath with fresh solutions of soda ash, with or without trisodium phosphate, would, upon draining the bath, still leave a tar-like coating



Brain Tester

Sharpen your wits on this little problem, then check your answer with the one given on page 168:

THE STOWAWAYS ON THE TRAVELING CRANE

A FLY, a gnat and a flea go for a joy-ride on a traveling crane. The fly falls asleep on a cushion in the cab, while the gnat makes himself comfortable on the carriage. The flea, more venturesome, hangs by one arm from the crane hook. In one minute, the crane travels 9 ft along the craneway, while the carriage traverses 12 ft over the crane. Meanwhile the hook is raised 20 ft. How far does each of the insects travel in one minute?

that no amount of jetting with hot or cold water, steam, or air, would remove.

My master mechanic noted, that as the boiling solution was drained, the instant a tube appeared above the surface the gummy coating was almost liquid, but that it quickly congealed on exposure to air. He closed the drain, refilled the bath, and turned on the steam until it was again boiling vigorously. At this point he threw a canvas tarpaulin over the bath, and after waiting until the air space under the canvas had become thoroughly heated and saturated with moisture, he again opened the drain but left the steam turned on. When the bath was empty, the steam turned off, and the canvas removed, we found that the combination of hot saturated atmosphere and condensing steam under the canvas had satisfactorily removed that troublesome coating on the tubes.

Tecumseh, Kansas H M NAYLOR

Boils Coolers in Oakite Solution

IN OUR PLANT, we clean oil coolers by boiling in a solution of 17 lb of "Okemco" to about four barrels of water. We boil for about one hour, remove the bundle, and wash it with hot water under pressure. Boiling alone does not remove the sludge from the tubes back in the bundle. The hot water under pressure will wash it out after the boiling has loosened it.

Another method is to pump the Oakite solution through the oil side of the cooler, keeping it hot with a steam coil. Several hours are required to remove all the sludge. By using an open tank, you can see when the solution returning from the cooler is not carrying any more dirt. This method saves removing the bundle but takes about as long and you cannot be sure all parts are clean.

Walthill, Neb. W W DINGWALL

Heated Pine Oil a Satisfactory Solvent

THE WRITER has tried various solutions and methods of cleaning oil-cooler tube bundles of the type and size described by TDO, but distilled pine oil has proved to be the only thoroughly satisfactory solvent.

The bundle should be completely immersed in the oil bath, and for this purpose, a suitable vat or tank can be made from a cylindrical steel tank mounted on a horizontal stand of convenient height. An opening in the upper side should be provided for the insertion of the bundle. A heating coil composed of three or four lengths of 1-in. pipe can be placed in the bottom of the tank, fitting its curvature, and connected to a source of low-pressure steam. Condensation should be discharged through a trap.

Best results will be obtained by heating the oil, although it does not need to be heated to the boiling point. Cleaning is more rapid at elevated temperatures, but loss of oil due to evaporation is correspondingly greater. However, one charge of oil is usually sufficient for several cleaning operations. Satisfactory cleaning may be obtained also by diluting the pine oil, but more time is required to accomplish the desired results. Cleaning may be expedited by turning the bundle from time to time to remove the sludge deposited on the inner portion. After the bundle has been removed from the bath and while it is still warm, it should be rinsed under a strong stream of water to remove traces of sludge. A stream from an ordinary water hose is sufficient.

Greensboro, N. C. C E KERCHNER

BRAIN TESTER

Answer to problem on page 167

IN ONE minute the fly travels 9 ft, the gnat 15 ft, and the flea 25 ft.

It's easy to figure if you remember the old carpenter's rule that a right triangle with one leg 3 and the other 4 will have a hypotenuse of 5. Clearly the fly in the cab travels just 9 ft in one minute. The gnat moves along the hypotenuse of a right triangle of which one leg is 9 ft and the other 12. From the 3-4-5 rule, it is certain that the gnat travels 15 ft in a horizontal line at an angle with the walls of the room.

Throughout the entire voyage the flea stays directly beneath the gnat, so he must move 15 ft horizontally and 20 ft vertically. Applying the 3-4-5 rule again, his actual path must be a line 25 ft long, inclined both to the walls and the floor.

The moral of the fable is that the bird who takes the biggest chance gets the longest ride.

Boil Tube Bundle in Caustic-Soda Bath

REMOVE bank of oil-cooling coils, and place it in a wood or steel vat large enough to allow complete submergence. Fill vat with water and add from 50 to 100 lb of caustic soda, either flake or solid form. Put steam into water with a steam hose, which will boil mixture as well as stir it.

In one to three hours, the coil assembly will be perfectly clean. Suggest unbolting cooler head in order to clean inside also. Rinse thoroughly with clear water and blow out with compressed air or steam. Reassemble heads, using sheet cork gasket $\frac{1}{16}$-in. thick. The entire job should be done outside of the power house, as it is rather messy.

Birmingham, Ala. E P WINTERS

Mixture of Gasoline and Compressed Air

AFTER trying to clean tube bundles of turbine-oil coolers by boiling in water to which soda ash or various patented cleaning compounds had been added, without much success, I have found that good results can be obtained by using gasoline and compressed air.

The tube bundle should be placed in a horizontal position, supported a few inches off the ground by blocks. Then with a jet of air blowing on the section to be cleaned, a little gasoline should be poured directly in the air stream, and this procedure continued until desired results have been secured. A container or pan of some sort can be placed under the tube bundle to catch surplus gasoline, which can then be used over again.

An air pressure of 50 lb or more should be used, and to avoid fire hazards, this work should be done in the open air, and away from nearby buildings.

Torreon, Mexico C G HERSHEY

Cleans with Carbon Tetrachloride

AFTER EXPERIMENTS with various classes of solvents, it has been our experience that the best job can be done with carbon tetrachloride (Pyrene). As this solvent must be circulated at relatively high velocities in order to speed up its cleaning action, we have rearranged valves and piping to an infrequently used oil-transfer pump so that it and the oil cooler may be segregated from the turbine-lubricating system, and connections have been provided for the solvent-circulating piping.

During the cleaning operation, the pump takes its suction from a drum containing the solvent, and discharges into the bottom of the cooler. An overflow pipe from the top returns the liquid to the drum. Enough cleaning fluid is required to fill the oil-cooler passages, the circulation lines, and the drum to a level that will insure constant flow to the pump suction. It rarely requires more than 24 hours to clean the coolers serving our 3000-kw units.

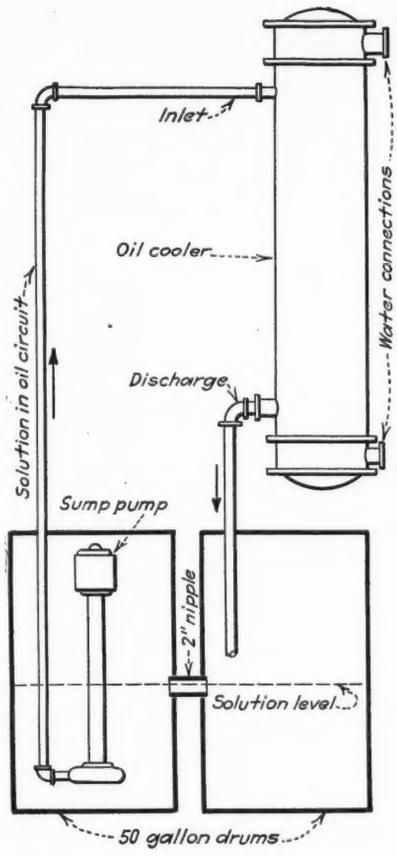
Because of its high cost, we have found it desirable to use the carbon tetrachloride for several cleanings. In plants where large quantities are used, it might even prove economical to rig up a makeshift distillation outfit to separate the impurities from the solvent.

Roanoke, Va. S H COLEMAN

Solves Similar Problem

I HAVE just finished cleaning an oil-cooler similar to that described by TDO, in the following manner: Oil-inlet and -discharge lines were disconnected from the cooler, and the openings were bushed to take $\frac{1}{2}$- or $\frac{3}{4}$-in. pipe. Then the heads were cut from two 50-gal. oil drums which were connected together with a nipple about 2-in. long, near the center line (see sketch). A small sump pump was set in one drum, its discharge connected to the top opening in the cooler. The discharge from the bottom of the cooler was into the other drum, permitting continuous circulation.

The drums were filled to the connection between them with a strong solution of #22 Oakite, which was boiled for half an hour by a small steam coil. Solution should be kept at around 160 F.



In four hours, a cooler was cleaned by this method that had not been cleaned for four years.

Piqua, Ohio SAM PICKERING

Boiler Water Problem

WE OPERATE *a 1500-kw power plant in a corn-products factory. I am very anxious for information on the sulphate-carbonate ratio in boiler water. We have two B & W water-tube, cross-drum pulverized-coal-fired boilers evaporating 38,000 lb per hr at 400 lb and 540 F. Blowdown-water analysis is as follows:*

total solids, ppm	*1520*
sodium hydroxide (NaOH)	*608*
sodium carbonate (Na_2CO_3)	*201*
total alkalinity as Na_2CO_3	*1028*
sodium sulphate (Na_2SO_4)	*285*
phosphate (PO_4)	*43*

Feedwater: Alkalinity (MO) 97.5. Total hardness 140. Phosphate (PO_4) 12. What puzzles me is that the above sulphate-total alkalinity (carbonate) ratio is the reverse of ASME boiler Code 3:1 ratio. Also, I want to know how phosphate reacts chemically. However we have had no embrittlement troubles so far.—ILC

[*The foregoing question was submitted by* POWER *to W J Ryan, Water Service Laboratories, New York, N. Y. His reply follows*—ED.]

There are several considerations not made clear in ILC's letter. From the feedwater analysis, it appears to contain a large amount of sodium alkalinity, as shown by the fact that alkalinity is so much in excess of hardness. He does not say whether the feedwater is a treated water or a natural water, but from the presence of phosphate and the high sodium alkalinity, it is probably a treated water. If it is a treated water, it seems to be greatly over-treated with soda-ash.

Also puzzling is the fact that the sodium alkalinity of the boiler water is not much higher than the sodium alkalinity of the feedwater, which may be a result of blowdown water having been sampled soon after a shut-down and refilling of the boiler, or the feedwater sample may have been taken during some abnormal condition. Or it may be that the analysis given is of the makeup water rather than the feedwater and that a very small amount of makeup is used, while the boilers are blown down a relatively large amount.

Without having a complete raw-water analysis, including the amount of sulphate, and a description of any treatment now being used, it is not possible to say just how the desired sulphate-carbonate ratio could be obtained in the boiler water.

If the water is now being treated with soda-ash in an external softening plant, it may be possible to reduce excess soda-ash, and add sodium sulphate to the water in the desired amount.

If water is not being treated, and if it naturally contains such a large amount of sodium alkalinity as is shown by the analysis, the only practical way to bring the sulphate-carbonate ratio up to 3:1 is to treat the water with sulphuric acid to convert the greater part of the sodium alkalinity (presumably sodium bicarbonate) to sodium sulphate, thus:

$$2NaHCO_3 + H_2SO_4 = Na_2SO_4 + 2H_2O + 2CO_2$$

Following the acid treatment, the water must be aerated to expel CO_2 formed by the acid reaction.

Leading manufacturers of water-treating apparatus can furnish complete equipment for applying acid in accurately measured amounts, and for aerating the water after the acid application.

It may also be desirable to soften the makeup water. The best method of softening could be determined only if complete information were available, including full analysis of the water, and the relative amounts of makeup and condensate fed to the boilers.

When phosphates are used for water treatment, they react with the calcium and magnesium salts in the water to form insoluable tricalcium phosphate and trimagnesium phosphate.

The reaction between trisodium phosphate and calcium bicarbonate is:

$$3\ Ca(HCO_3)_2 + 2Na_3PO_4 = Ca_3(PO_4)_2 + 6\ NaHCO_3$$

and the reaction of disodium phosphate with calcium bicarbonate is:

$$3\ Ca(HCO_3)_2 + 2Na_2HPO_4 + 2NaOH = Ca_3(PO_4)_2 + 6NaHCO_3 + 2H_2O$$

Reactions of the phosphates with the other calcium and magnesium salts are similar to those given here. The caustic soda (NaOH) in the last reaction is formed by the breaking down of $NaHCO_3$.

New York, N. Y. *W J Ryan*
Water Service Laboratories

Power Lines

Utilities Announce New Construction

Detroit Edison Co is planning to spend $18,000,000 on new construction during 1938, the largest construction budget since 1930. On the basis of present plans, $7,900,000 will be spent on generating equipment, $1,800,000 on substation construction, $2,400,000 on overhead and underground transmission lines, $3,100,000 on new-business connections, and $2,800,000 on miscellaneous construction and purchase of equipment.

Of the expense for generating equipment, $4,500,000 to $5,000,000 will be spent on completion of 75,000-kw turbine-generator at the Delray plant, and about $2,500,00 for replacement of a 45,000-kw unit at the Conners Creek plant with a 60,000-kw set.

United Light & Power Co, American Light & Traction Co and their subsidiaries will spend an estimated $18,000,000 on construction during 1938, C S McCain, president, has announced. This compares with construction expenditures of $14,000,000 for 1937.

Of the aggregate, about $5,000,000 will be spent by Columbus & Southern Ohio Electric Co on construction of 30,000-kw additional boiler and turbine-generating capacity. About $3,200,000 will be spent by Kansas City Power & Light Co on construction of 25,000-kw additional generating capacity. Part of this work was accomplished during 1937. Madison Gas & Electric Co will expend about $1,800,000 on the construction of 20,000-kw additional generating capacity. The remainder will be spread throughout the system.

Chelsea Hydro Station Plans 34,000-Hp Unit

Gatineau Power Co (Ottawa) has applied to the Provincial Electricity Board of the Province of Quebec for approval to spend about $750,000 in 1938 for additional generating and transmission-line capacity.

Principal item will be an additional 60-cycle, 34,000-hp generating unit at the Chelsea hydroelectric plant on the Gatineau River six miles north of

Ottawa. This will be the fifth 34-000-hp unit at Chelsea and will complete that station to its full designed capacity of 170,000 hp. The other major item will be a second 110,000-volt circuit to be added to the existing six-mile transmission line from the Farmers hydroelectric plant, one mile south of Chelsea, to its Val Tetreau switching station in Hull, Quebec.

With the new unit at Chelsea, Gatineau Power Co will have a total installed hydroelectric-generating capacity of 506,500 hp in its Gatineau River plants and a grand total of 713,934 hp, of which 608,684 hp will be in interconnected plants on the Gatineau River, the Ottawa River, and on other tributaries of the Ottawa.

Ice Jam Swamps Ontario Hydro Plant

Ice from the worst jam on record in the upper end of the Niagara River gorge at Niagara Falls on Jan 24-25 almost completely filled the interior of the Ontario hydroelectric plant and caused unknown damage to the generating units. The plant, 778 ft long, 80 ft wide and 46¼ ft high (above generating-room floor), houses 15 reaction-type turbines with horizontal-twin-runners, varying in capacity from 11,500 to 17,00 hp each. Total rated capacity is 205,000 hp. Generators are ac, 3-phase, 12,000 volts, 25-cycle, 7500 to 15,000 kva; total rated capacity 134,000 kva.

Tail water (normal) is El. 342; generating floor El. 360, bottom of windows El. 388, top of windows El. 398, roof El. 408.

North Pole Descends

Water rise, caused by the ice jam and damming of the river below by ice, was 53 ft above normal, and the ice was lifted 6 ft higher. This put the ice almost to the roof level, and well above the bottom of windows. Water and ice poured into the plant, mostly from south end windows, where the ice jam was the worst. Apparently a big berg or mass of ice that formed at the American Falls, was shifted across the river and lodged close to the upper riverside corner of the plant, thus forming a chute for the ice and water that came down over the Canadian end of the Horseshoe Falls, directing the flow directly against the end of the power house. The ice level at the lower (downstream) end of the plant was 13 ft lower than at the upper end.

The entire south or upstream half of the power house was filled with ice to the base of the windows (also the elevation of the crane rail), and in some places was even as much as 8 ft higher. Generators were covered from 18 to 20 ft. deep with ice, and given a good soaking from the accompanying water. Water drained out in a short time as the river scoured out a channel under the ice bridge. Units from the center northward were buried to a lesser extent.

Arthur S Robertson, district superintendent of the Hydroelectric Power Commission of Ontario, owner and operator of the Ontario plant, is unable even to estimate the damage. The plant was shut down in advance of flooding; its load is being carried by the Queenston plant at the mouth of the gorge. A dragline has been taken down the road leading down the side of the gorge to the plant in order to clear the ice from the lower end of the road. A small gas shovel will be taken into the plant as soon as access is provided by the dragline, and the ice will be loaded and hauled out in trucks.

Meantime, electric and coke heaters have been placed within the plant to keep the ice soft. Generators will be turned over slowly after the bearings have been cleaned and re-oiled, and short-circuited in an attempt to dry out the windings. A motor-generator exciter is being dried out inside a wood and canvas frame, which will supply badly-needed direct current for operating the overhead cranes. Crane motors were not submerged, but got a good splashing. If the coils in the main machines cannot be dried out successfully, they will be replaced, in the opinion of Mr Robertson.

In 1909 the water came up to El. 378 in another ice jam, and flooded the plant, though there were not as many units in operation at that time.

—*Wide World Photo*

ICEMAN'S PARADISE

But not for the Ontario hydro plant. South end of plant, through which ice entered, is almost out of sight beneath the ice jam

—*Photo by Edwin H. Hodge*

HELL ON ICE

A faint inkling of the type of emergency a power engineer has to face. This one occurred in late January at the Ontario hydroelectric plant. Ice, lifted almost to roof level, and water poured into the plant from south-end windows, causing unknown damage to generating units.

Utility and Oil Co Swap Services Again

Contract for a second 35,000-kw steam plant to be built by Pacific Gas and Electric Co on property of an oil refinery remains only to be approved by the California State Railroad Commission. Almost an exact duplicate of the plant now being built at Tidewater Associated Oil Co's refinery at Avon, Calif., the new one is scheduled to be completed in 1939 in nearby Martinez for the Shell Oil Co.

Both contracts provide for sale of electric energy and steam to the refinery, and for purchase from the refinery of petroleum sludge or equivalent fuel.

Like the first plant, contract for which was approved in October 1937, the one at Martinez will leave considerable capacity available to the utility, demand at the refinery being of high load factor and in the neighborhood of only 4500 kw.

Cost will approximate $5,000,000. A single turbine will take steam at 1500 lb, 950 F. Being negotiated are plans for a third similar unit for the Union Oil Co's refinery at Oleum, also in the same area east of San Francisco Bay.

Power Engineers Attend Fuel Conference

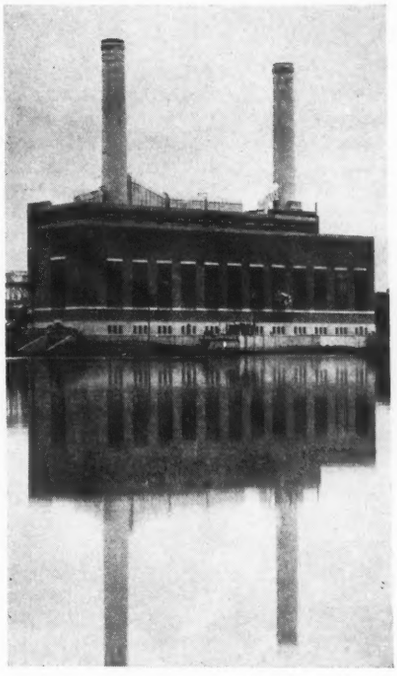
Several hundred power engineers from Florida, Georgia, N Carolina, S Carolina and Tennessee attended a fuel-engineering conference held by Appalachian Coals, Inc, in Atlanta, Ga., Feb. 8. Engineers participated in an all-day meeting, the 22nd in a series, in which application and utilization of industrial coals were discussed.

Papers presented at the meeting included, "Fuels of Today and Tomorrow," by Dr A C Fieldner, chief, Technologic Branch, U S Bureau of Mines; "Selection of Pulverized-Coal Equipment," by Ollison Craig, manager Engineering Dept, Riley Stoker Corp; "The Multiple-Retort Stoker—Its Modernization and Application of Water Cooling," by C W Baldwin, engineer, American Engineering Co; "The Spreader Stoker," by M Snodgrass, mechanical engineer, Detroit Stoker Co; and "The Nation's Power Supply — Its Economic Development Under Private Enterprise," by Frank F Fowle, president, Western Society of Engineers.

Neches Station Completes 25,000-Kw Condensing Unit

Neches Station at Beaumont, Texas supplies power to 300 miles of coastline territory of the Gulf States Utility Co. A new 25,000-kw condensing turbine-generator is supplied with 850-lb, 900-F steam by a 320,000-lb-per-hr, 3-drum Combustion Engineering Co boiler. Fuel is natural gas from nearby fields, but provision is made for oil firing.

Turbine and condenser are Westinghouse. The 3600-rpm turbine has three extraction points heating feedwater to



375 F. Low-pressure and high-pressure feedwater heaters are contact type, intermediate is surface type. A separate closed heater desuperheats high-pressure extraction steam and increases final feedwater temperature about 8 F. Makeup is evaporated intermittently as required, using extraction steam.

The new unit is self-sufficient, having an independent circulating water system, feedwater makeup, fans and auxiliary power supply. There is no cross connection between the new high-pressure-steam piping and the 360-lb header serving the two older 25,000-kw and 35,000-kw units.

University of Missouri Increases Capacity

On Jan 3 the University of Missouri ordered a 275-lb, 50,000-lb-per-hr steam-generating unit from Babcock & Wilcox Co and a 750-kw back-pressure turbine-generator from General Electric Co for its power plant at Columbia, Missouri.

The boiler is a cross-drum unit fired with a chain-grate stoker, having forced- and induced-draft, water walls, convection superheater and air heater. The turbine-generator will take steam at 255 lb and 600 F and exhaust to the heating system at from 30- to 70-lb, depending on heating requirements. The generator has a surface air cooler and shaft exciter. Shipment of the boiler is expected in June and of the turbine in October. All work is to be completed and new equipment in service by Dec. 1, 1938.

Midwest Power Conference Planned for April 13-15

The Armour Institute of Technology, in cooperation with six midwestern state universities, will hold a Midwest Power Conference in Chicago, April 13-15. The program planned for the conference involves some 30 papers presented by authorities drawn about equally from educational and industrial fields. Emphasis will be divided between steam, diesel, electric and hydro power.

Subjects to be covered include, "Advances in the Solution of Fuel Problems," "Trends in Electric-Power Equipment," "Developments in Stationary Power Plants," "Metallurgy of Power Plants," "Problems in the Operation of Power Plants," and "Valuation of Power Plants."

Registration and headquarters will be at the LaSalle Hotel, Chicago. Further information may be obtained from L E Grinter, Dean of the Graduate Div, Armour Institute of Technology, Chicago, Ill.

Chicago Air Conditioning Sets Record for 1937

New high-record marks both in number and capacity of air-conditioning installations made in Chicago were established in 1937, according to report of Commonwealth Edison Co.

575 air-conditioning plants were installed, compared with 432 in 1936, an increase of 33%. Capacity of these plants totaled 12,556 hp, compared with 8719 hp in 1936, a gain of 44%.

The total number of air-conditioning plants installed or contracted for in Chicago on December 31, 1937, was 1923 and the total capacity of these installations was 70,207 hp.

PERSONALS

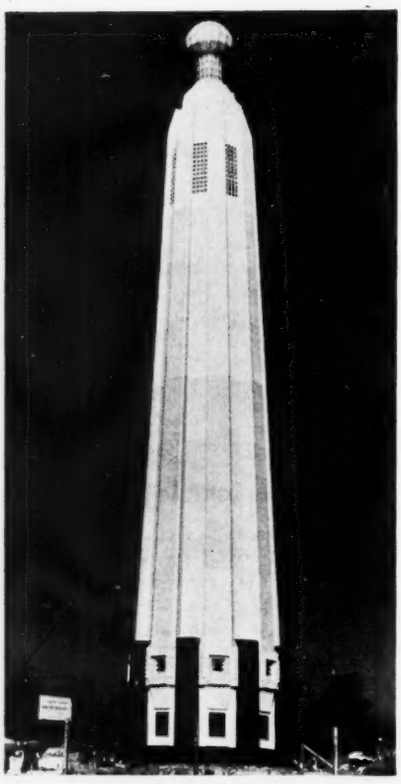
PROF WILLIAM N BARNARD has been named director of the Sibley School of Mechanical Engrg, Cornell University. A graduate of Cornell in 1897, he has been, with the exception of two brief periods, a member of the faculty ever since. He has been head of Heat-Power Engineering Dept for 18 years, and during the past year and a half has been acting director of Sibley School. His books on heat-power engineering, written in collaboration with C F Hirshfield and F O Ellenwood, are standard textbooks in the field.

JOHN S HAYES has been appointed district representative of Elgin Softener Corp, Elgin, Ill., for northwestern Ohio. His office is at 1508 River Rd, Maumee, Ohio.

W A MEITER was recently made manager of Worthington Pump & Machinery Corp's Buffalo office. He succeeds C C Scott, who will devote his entire time to special work in the Buffalo district.

MALCOLM BLACK has been appointed district sales manager by Manning, Maxwell & Moore, Inc, of a newly created South Central District with headquarters at 533 Mayo Bldg, Tulsa, Okla. Mr Black, who has represented this company as sales engineer of the Tulsa territory for several years, was formerly connected with Oklahoma Gas & Electric Co at Enid, Okla., and the Continental Oil Co at Ponca City, Okla.

(Continued on page 132)



EDISON MEMORIAL

DEDICATED on Feb 11, the Edison Memorial Tower at Menlo Park, N. J. commemorates the invention of the electric light and the site of Thomas A Edison's laboratory where the first practical lamp was produced and tested. The tower rises to a height of 131 ft above ground level. Atop a 117-ft concrete-slab structure, in a steel frame, is a 13-ft, 8-in. replica of an incandescent lamp, which, nightly, will shine over the surrounding countryside.

This large bulb is serviced by four 1000-watt, four 200-watt and four 100-watt bulbs. It is composed of 153 pieces of amber-tinted pyrex glass 2 in. thick; weight exceeds 3 tons.

STRAWS

Pointing the way business winds blow

ARKANSAS——Sebastian County Mutual Power Co, Fort Smith, plans steam-electric generating plant, with transmission and distributing lines, power substations, etc. Cost about $175,000.

El Dorado is considering municipal electric plant. To arrange financing for about $660,000 through Federal aid. George R Crosley, mayor, active in project.

CALIFORNIA——Roman Catholic Archdiocese, Los Angeles, plans electric plant and central-heating plant at proposed St. John's Seminary. Cost about $750,000.

General Petroleum Corp, 108 West Second St, Los Angeles, plans pumping station, boiler plant and switch house at oil refinery at Torrance, to cost about $150,000.

Cal-Juices, Inc, subsidiary of Mutual Orange Distributors, Inc, 514 East Eighth St, Los Angeles, plans steam power house for processing and heating service at new citrus-fruit-byproducts plant at Anaheim.

Metropolitan Water District, 306 W 3rd St, Los Angeles, contracted Northern Pump Co, Minneapolis, Minn., for 65 motor-driven lubricating-oil pumps, including driving motors, for Colorado River aqueduct.

(*Continued on page* 124)

NEW PLANT CONSTRUCTION

McGraw-Hill Business News Department Is Prepared to Furnish a More Complete Daily Service

Ark., Gurdon—City, G. W. Carlisle, mayor, plans to seek federal funds for construction of municipal light and power plant building, equipment and distribution system. **$100,000.**

Calif., Alturas—Surprise Valley Electrification Corp., brick, concrete power plant, force account.

Calif., Avon—Pacific Gas & Electric Co., 245 Market St., San Francisco, plans power plant. $1,000,000 or more.

Calif., Oleum—Pacific Gas & Electric Co., 245 Market St., San Francisco, plans steam electric power plant. $1,000,000 or more.

Colo., Colorado Springs—Broadmoor Hotel, Inc., S. Penrose, pres., Broadmoor Hotel, M. J. Strong, construction supt., Broadmoor Hotel, power plant changes at Broadmoor Hotel, involving changing entire plant from D.C. to A.C., incl. much new wiring, all new equipment and conversion of plant as well as new kw. steam turbine and dynamo ordered from General Electric Corp., owner builds, work starting at once. New automatic high-speed elevators will also be installed. Est. $125,000.

Ill., Jacksonville—City, H. H. Vasconcellos, mayor, bids about Mar. 1, constructing 68x75 ft., brick, concrete municipal power plant, 24 ft. high, and basement 10 ft. deep, switching station, 3 diesel engines approximately 660 kw. with generators, exciters, accessories, switchboard and control equipment, station transformers, starting equipment, oil supply and storage system, water cooling and circulating system, lubricating oil system, distribution system, incl. 8,000 ft. armored underground cable complete with switching station equipment for controlling feeder circuits, and series of street lighting circuits, overhead primary feeder, secondary distribution system, incl. 2,500 poles complete with copper conductors, insulators, hardware, cross arms, braces, etc., 210 service transformers, 2,000 service meters, 400 street lights, etc. $420,000. K. K. Stapleton, city engr. Warren & Van Praag, Inc., Milliken Bldg., Decatur, consult. engrs.

Ind., Huntington—Bd. P. Wks., C. W. H. Bangs, mayor, City Hall, employed Burns & McDonnell, consult. engrs., 107 West Linwood St., Kansas City, Mo., to make surveys, improving central heating plant. Northern Indiana Public Service Co. has filed petition with State Public Service Comn. for permission to discontinue central heating plant service.

Ia., Clinton—City Council will not construct municipal electric light and power plant. (**Correction**—Status.)

Ia., Onawa—Bids Mar. 2, by City Council, improving municipal electric light and power plant, consisting of removing part of existing plant and equipment together with installation of one new diesel engine outfit, approximately 625 B.H.P. in size together with switchboard equipment. Est. about $60,000. Buell & Winter, Sioux City, Ia., engrs.

Kan., Leavenworth—Bids Mar. 15 to Apr. 1, by City, constructing new intake and electric driven low service pumps and 18 in. discharge line to present settling basins, 4 m.g. filter plant with storage reservoir and electric driven high service pumps, concrete floor and cover for Pilot Knob Reservoir. $290,000. Black & Veatch, 4706 Bway., Kansas City, Mo., engrs.

Ky., Beattyville—City defeated $90,000 bonds, for constructing power plant (**Correction**—Status).

Ky., Louisville—Louisville Gas & Electric Co., 311 West Chestnut St., plans constructing sub-station at Breckinridge and Dutchman's Lanes, near Taylorville Rd. $98,625. Private plans.

Ky., Vanceburg—City, J. A. Hallsted, clk., plans municipal light and power plant, $148,000 bonds approved. **Maturity probably not until spring.** H. N. Herrman, 3946 Ledgewood Dr., Cincinnati, O., engr.

Me., Lewiston—Bids Mar. 1, by City, D. J. Levesque, mayor, City Hall, pumping station improvements in connection with new water pumping and electric power system, P.W.A. 1012-1-P-DS. Est. about $200,000. G. Z. Bernier, supt. Whitman & Howard, 89 Broad St., Boston, Mass., engrs.

Mich., Detroit—Detroit Edison Co., 2000-2nd St., plans expending $18,000,000 for replacement and betterment program for 1938, incl. generating equipment $7,800,000, new substation construction $1,800,000, transmission lines $2,400,000, connections, transformers, etc., for new customers $3,100,000 miscellaneous construction as heating additions warehouses, etc., $2,800,000.

Mich., Hillsdale—City election Apr. 18, to vote $130,000 bonds to finance (in part) brick, steel, rein.-con. addition to municipal power plant, plain found., incl. diesel engine unit, $200,000. Hamilton & Weber, 1440 Mackinaw Rd., S. E. Grand Rapids, consult. engrs.

Minn., Glenwood—City election late in February to vote $200,000 bonds for power plant generating equipment and electrical and distributing system. This job was awarded on bids several years ago and so reported. Local power concern then and now serving city tied project up in court. Recent Federal Court decision on P.W.A. aid to public utilities has reopened subject. F. P. Schaub, city engr. Burlingame, Hitchcock & Estabrook, 521 Sexton Bldg., Minneapolis, consult. engrs.

Mo., Kennett—City soon takes bids constructing two 400 kw. diesel engines, with alternate bid on three 250 kw. engines. Burns & McDonnell Eng. Co., 107 West Linwood Blvd., Kansas City, engrs.

Neb., Lincoln—City Light & Power Dpt. retained Black & Veatch, engrs., 4706 Bway., Kansas City, Mo., at contract price of $3,000 to make inspection of city power plant. This is preliminary to large improvements, incl. new boilers, new switchboard, also miscellaneous other smaller changes. $175,000. D. L. Erickson, city engr.

N. Y., Buffalo—Buffalo Niagara Electric Corp., Electric Bldg., Buffalo, plans constructing electric terminal power station, in south or east section of city. $1,500,000.

N. Y., Plattsburg—City, City Hall, made sketches constructing diesel electric generating plant and electric distribution system. $520,000. To be financed by P.W.A. funds. LeR. Brown, city engr. **Maturity later in 1938.**

O., Toledo—Toledo-Edison Co., Edison Bldg., J. F. O'Connor, vice pres., plans expenditure $1,900,000 in 1938 on new turbines, boiler plants, line extensions, incl. steel tower, transmission lines to Pemberville.

Okla., Anadarko—City in market for 750 hp. Diesel engine and electric generator. $80,000. F. J. Callahan, mayor.

Okla., Jay—H. E. Walter, 1309 East 10th St., Oklahoma City, plans light and power plant. City held election Feb. 15 on franchise. Private plans.

Okla., Miami—City Comn., in market for 1,500 hp. diesel engine and electric generator, new unit for municipal light plant.

Pa., Myerstown—Borough Council, J. G. Good, pres., Borough Hall, rejected bids opened Nov. 26, on Feb. 1, for municipal light and power plant, $68,715. May readvertise. G. W. Scott, Reading, engr.

S. D., Flandreau—City approved $158,000 bond issue for light and power plant. Will purchase the privately owned plant of the Union Public Service Co. and will also make improvements of same.

Tenn., Chattanooga—City plans constructing electric plant. $6,446,212. S. R. Finley, chn. and ch. engr. Electric Power Bd.

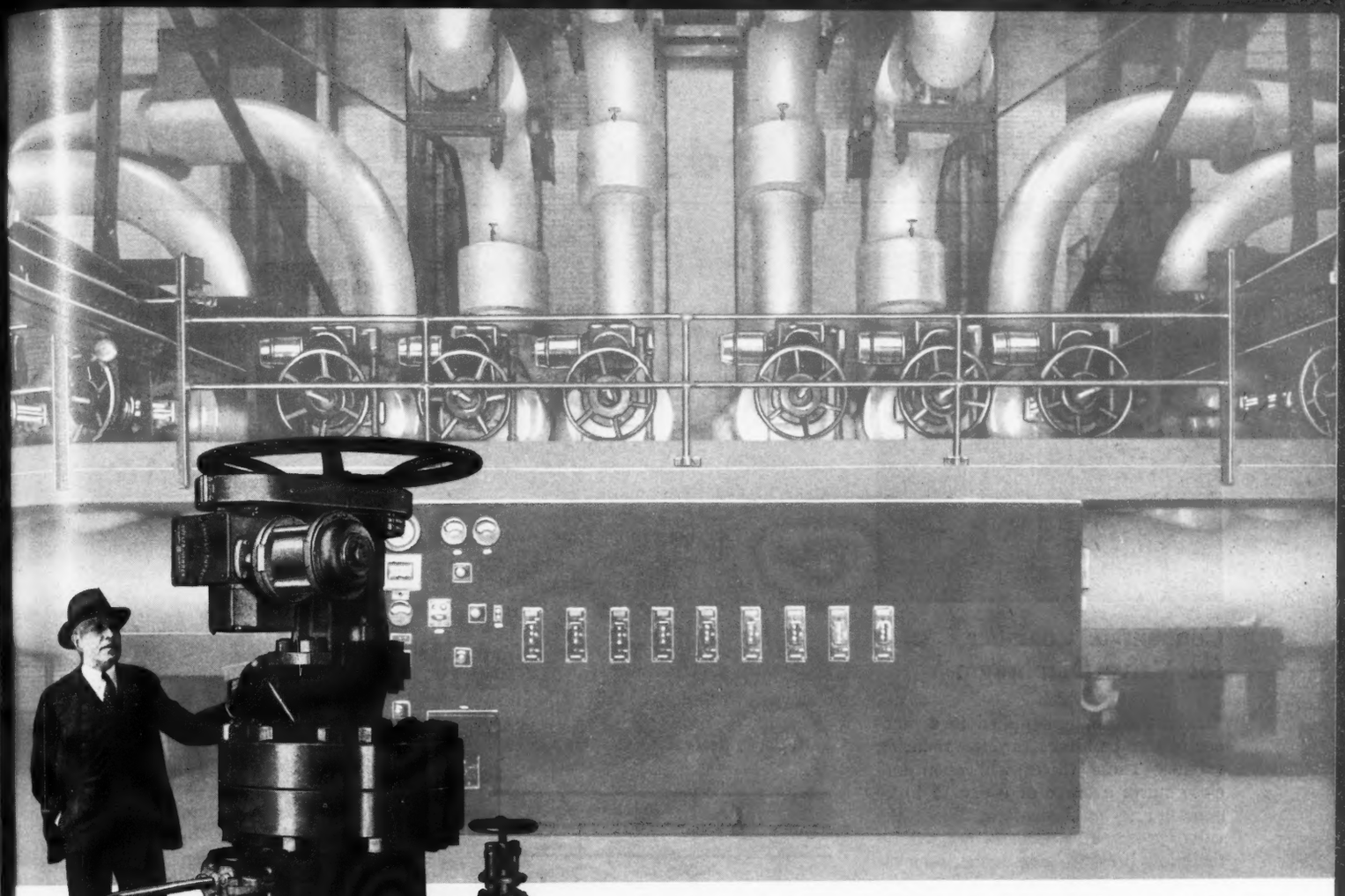
Tex., Plano—City, H. D. Steenson, secy., P.W.A. allotment rescinded for constructing municipal generating plant and distributing system, incl. plant building. $100,000. G. Smith, 2509 Lindenwood St., Dallas, engr.

Wash., Tacoma—City soon takes bids two 110 k.v. 600 ampere oil circuit breakers, two 20,000 kva. 110/13 k.v. transformers, four 110 k.v. disc switches, 3-pole together with necessary appurtenances and equipment, for installation at Cushman Power House No. 2. $121,700.

Egypt, Cairo—Ministry of Public Works, plans by Mechanical and Electrical Branch, for extending Valley of Kings Power Station at Luxor. $1,250,000.

Northern Ireland, Belfast—Hendron Brothers, Ltd., Cromac Bldg., 16 Eliza St., interested in prices of house lighting plants, house pumping plants, electric and gasoline driven, also water turbines, 5/50 hp. Cables "Hendron Belfast."

South Africa, Umtata—Bids Mar. 24, by Town Clerk, supplying and erecting two generator units each consisting of 200 kw., 3 phase, alternating, direct coupled to a heavy oil engine, with automatic starting equipment, 3,300 volt switchgear, full storage plant, hand operating cranes of lifting capacity 5 tons, and runway, complete with all piping, auxiliaries, apparatus and accessories necessary to make the unit complete for generating electric power.



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SPECIFIC METALLURGY. Steam temperatures at 900° and above eliminate the possibility of haphazard choice of valve materials. C-H units also employ the specific alloy and treatment best suited to the function of each part. Write for specifications.

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So it is wholly natural that Cutler-Hammer Valve Control units should win widespread preference. No matter from what angle C-H units are studied, they demonstrate the characteristic "power plant" engineering . . . in their specific metallurgy of all parts, the unique motor construction, the entirely exclusive operating features which make their performance outstanding. Consult with the nearest Cutler-Hammer representative. CUTLER-HAMMER, Inc., *Pioneer Manufacturers of Electric Control Apparatus,* 1209 St. Paul Ave., Milwaukee, Wis.

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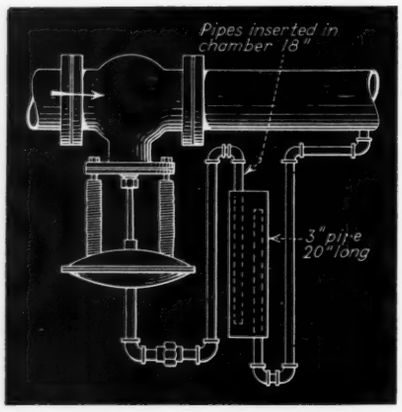
Practical Aids to Operation



Condensate Chamber for Valve Diaphragm

HEATING steam is supplied to a number of our buildings through reducing valves. These valves will open and close on an average of every 15 to 20 min. during mild weather. When the valves close, a vacuum is created on their low pressure side, which removes the sealing water from under the diaphragms.

When the valves opened again, the rubber diaphragms would be exposed directly to the steam until some of it condensed. This, of course, caused short diaphragm life. To overcome the difficulty, a condensate sealing chamber, made as indicated in the figure, was installed. The chamber is made of a piece of 3-in. pipe, 20 in. long, closed at both ends by welded-on disks. The pipe from the steam line to the valve diaphragm extends 18 in. into the chamber. These chambers have eliminated completely the diaphragm trouble.

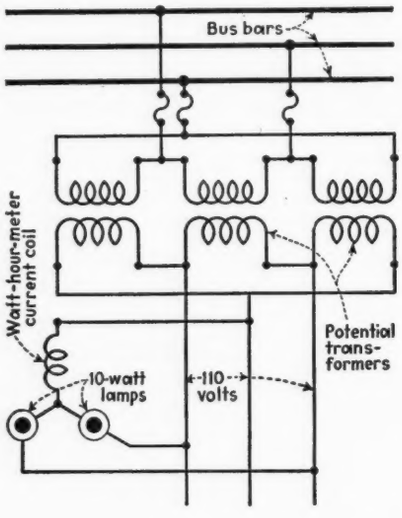
Poughkeepsie, N. Y. GEORGE PASCOE

Contaminated Feedwater Causes Boiler Trouble

MANY steam-power plants have the services of a chemist and, consequently, any abnormality in feedwater is detected before serious damage is done. Frequently, however, operators of small plants use any water that is easily obtainable. In one case, the operator of a cane mill found it necessary to replace tubes in a horizontal shell boiler much too often. Apparently, something was literally eating tubes away in a short time. Water-supply was a shallow well. An investigation showed that the water was contaminated with acid that had seeped in from a nearby pile of cane cullings.

Another instance of serious trouble caused by impurities in boiler feedwater occurred were yellow-pine sawdust was allowed to accumulate in a small stream and thus contaminate it with resinous material. This caused the water to foam in the boilers, often causing it to appear high in the gage when it was too low in the boilers. Once the water became so low that rear ends of the upper tubes were overheated, causing such a bad leak that the fire had to be drawn until the tube ends could be expanded. When water gages were found in perfect condition, the blame had to be laid on foaming water. After the sawdust was removed, foaming ceased, as well as the troubles resulting therefrom.

McCool, Miss. BUNYON KENNEDY



Instrument Checks Phase Rotation

IN INSTALLING a small 3-phase ac generator to operate in parallel with two others already in service, it was necessary to check phase rotation. As I did not have an indicator with me and there wasn't a 3-phase motor available, I used the arrangement shown in the figure. With an inductance and two lamps connected as shown, for one direction of phase rotation one lamp will go dim, and for the opposite direction of rotation the other lamp will go dim.

For inductance, I used the current coil in a 110-volt house-service watt-hour meter. The meter coil and two 10-watt lamps were connected in wye to the lead of potential transformers connected to the busbars. With one of the older generators in service, I marked the light that was dim. Then, taking this machine off the bus, the new machine was switched on and the same light went dim. The synchronscope already connected to the older machines was then connected to the new one and the machine paralleled in the usual way.

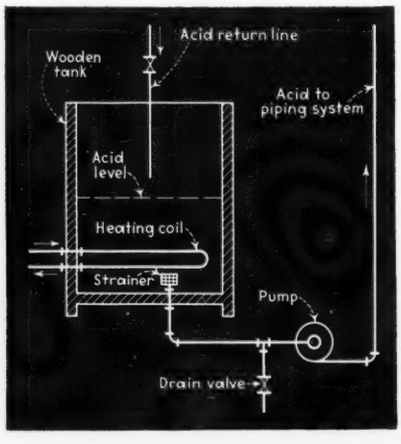
Kearny, Neb. ED SWAN

Removing Scale from Boiler-Feed Equipment

WHERE usual mechanical methods of scale removal are either impractical or impossible, acid solutions are often used to dissolve deposits in piping, heaters, pumps and valves of boiler-feedwater systems. Properly controlled cleaning with acid is faster, more thorough and, in the majority of cases, less expensive than cleaning with rotary cutters or by tedious hand chipping and scraping.

Commercial hydrochloric (muriatic) acid with approximately 28% pure hydrochloric acid (HCl) content is an effective scale solvent. An inhibitor must be mixed with the acid, to retard chemical action on the various metals with which it may come in contact. Formaldehyde (40%) added in the proportion of 1 quart to each 10 gal. of acid will serve the purpose. Iron, steel, copper and brass can be safely cleaned with this mixture provided the time during which the solution is in direct contact with the metal is reduced to a minimum.

Easily dismantled equipment such as valves, heater-tube bundles, pump impellers, etc, can be cleaned by immersing them in a wooden tank or vat containing the solution. Pipelines and more complex machinery are best cleaned by continuously circulating the solution through the encrusted spaces



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using a pump and wooden tank as in the figure.

Surfaces from which scale is being removed should be examined frequently and as long as any appreciable quantity of the deposit is undissolved, acid content of the solution should be kept above 12%. When only a thin layer of scale remains, solution strength can be diminished to around 5 or 6% acid. This will minimize any action on the metal and avoid waste of acid.

After all scale has been dissolved, metal surfaces must be thoroughly flushed out with fresh water. Addition of caustic soda to the wash water will assist in neutralizing any remaining acid.

The quantity of acid required and the dissolving time necessary is determined by the amount of scale originally present. Heating the acid will speed up the reaction. Wherever possible, the solution strength should be checked and the cleaning procedure supervised by a skilled chemist. Needless to say, all persons handling acids should wear goggles, rubber aprons, and rubber gloves to protect eyes, skin and clothing.

Roanoke, Va. S H COLEMAN

Drainable Drip Pans Made from Oil Cans

VERY neat and easy to make are these oil-drip pans made from empty discarded 5-gal. cans, cut with a pair of tin snips along the lines outlined at *A, B, C, D,* Fig. 1. Sides *A* and *B* are bent back to form the supports, Fig. 2. This type of drip pan has the advantage of complete drainage through the cap opening at its lowest point. The more common type of flat-bottom rectangular pan is more messy and harder to drain or empty. Fig. 3 shows the pans in place at an oil-supply stand.

Penacook, N. H. C H WILEY

Gasket-Sealing Loose Joints

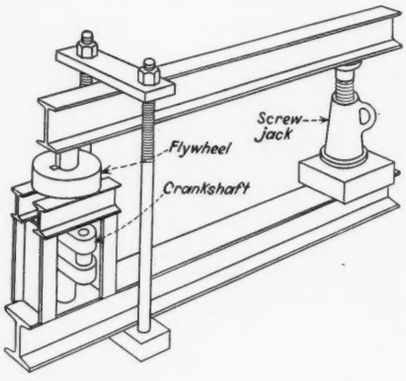
WHEN a gasketed joint is opened up for any reason, it is not advisable to use the old gasket again. The insurance of a tight job will more than compensate for the cost of a new gasket. In emergencies, where the old gasket must be reused, mark it at different points to guide replacement. If a used gasket is placed in any other position than the one it formerly held, and if there are any inaccuracies in the joint, leakage is almost certain.

Sheet-gasket materials are easily cut to exact size and shape required by using a hammer against the edges of the flanged joint after the material has been laid on top. Cutting of holes may be done either with a ball-ended punch, or with the ball pein of a machinist's hammer. Do not permit the gasket blank to slip during cutting. Slippage can be prevented by using a couple of clamps or a soft-wood plug in a hole on approximately opposite sides of the gasket. Except where gaskets are very large and flexible, two such plugs will suffice to hold the blank while all of the other holes are cut.

See that joints or flanges are carefully cleaned before applying a new gasket. A bit of the old gasket at a few points can easily ruin an otherwise good job. A sheet of emery cloth or sandpaper, attached to the face of a flat wood block, may be used to clean up the surfaces.

Pipe flanges should be carefully aligned to obtain a good tight job. Occasionally, it is very difficult to obtain perfect alignment; in such cases, if it is difficult to get a gasket that will hold, substitute a narrower one.

Peoria, Ill. J E HYLER



Homemade Press Pulls Flywheel

ON ONE of our recent overhaul jobs it became necessary to remove a small heavy flywheel from a crankshaft. Since this wheel was both keyed and pressed on, the task called for a rugged wheel puller or press. The illustration shows how we did the job with material at hand, a screw jack and some I-beams. The strong back and long bolts were easily made, and although the idea is possibly not new, it may find a place in most plant engineers' notebooks.

Boston, Mass. L W ROGERS

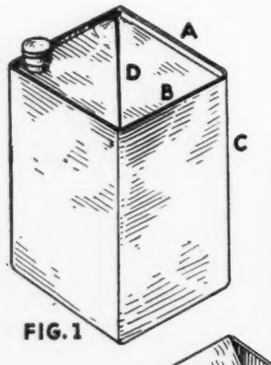


FIG. 1

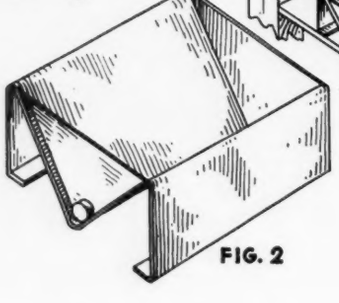


FIG. 2

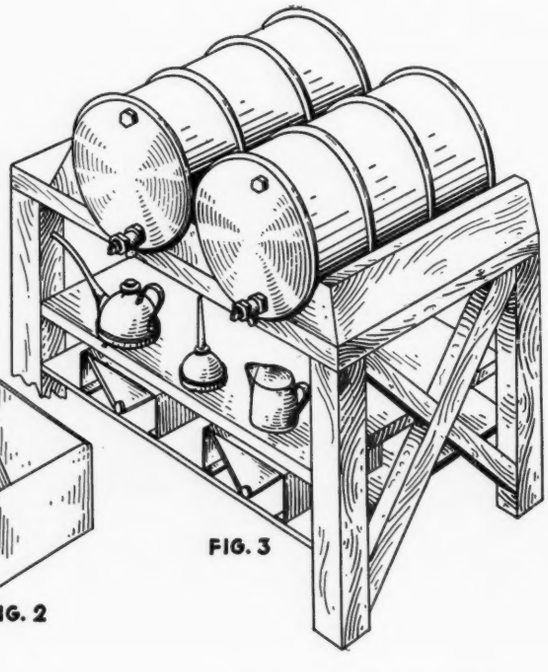
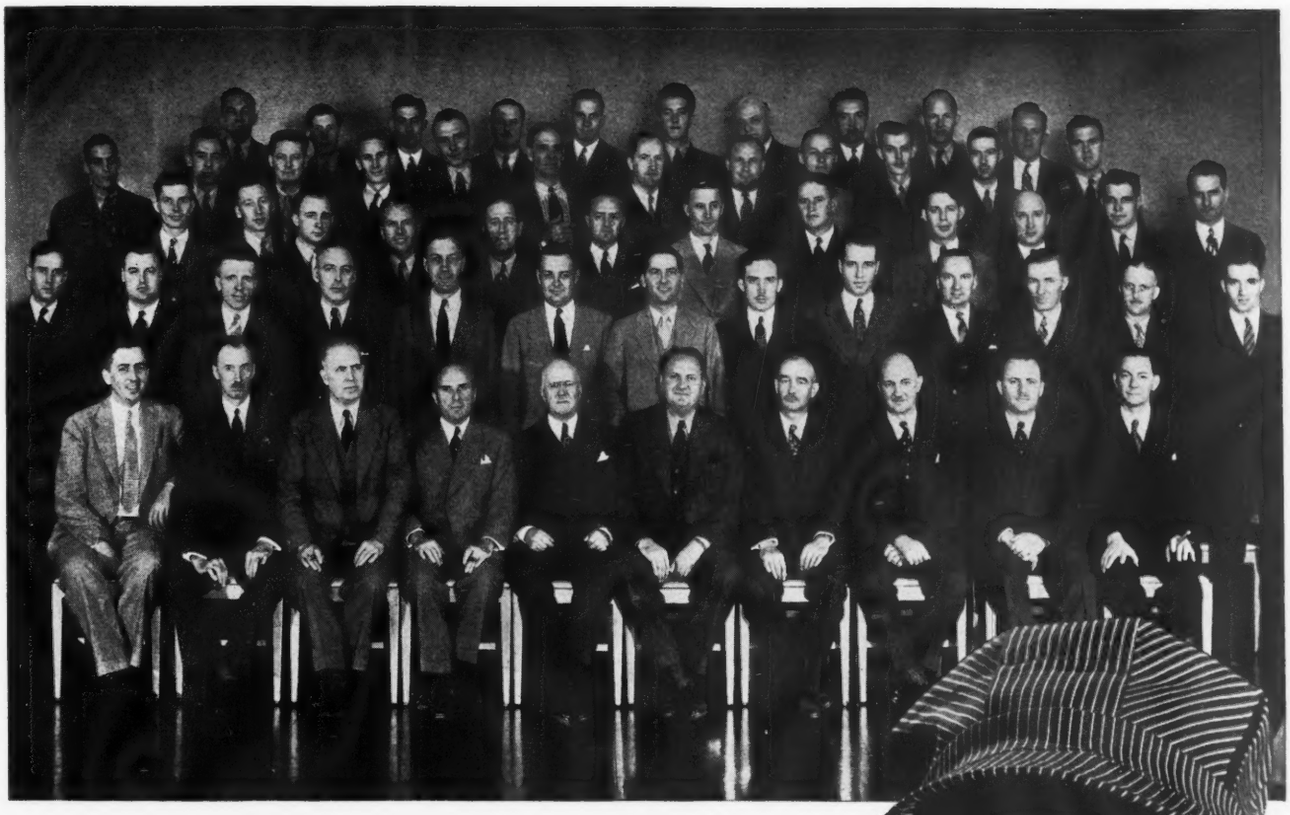


FIG. 3

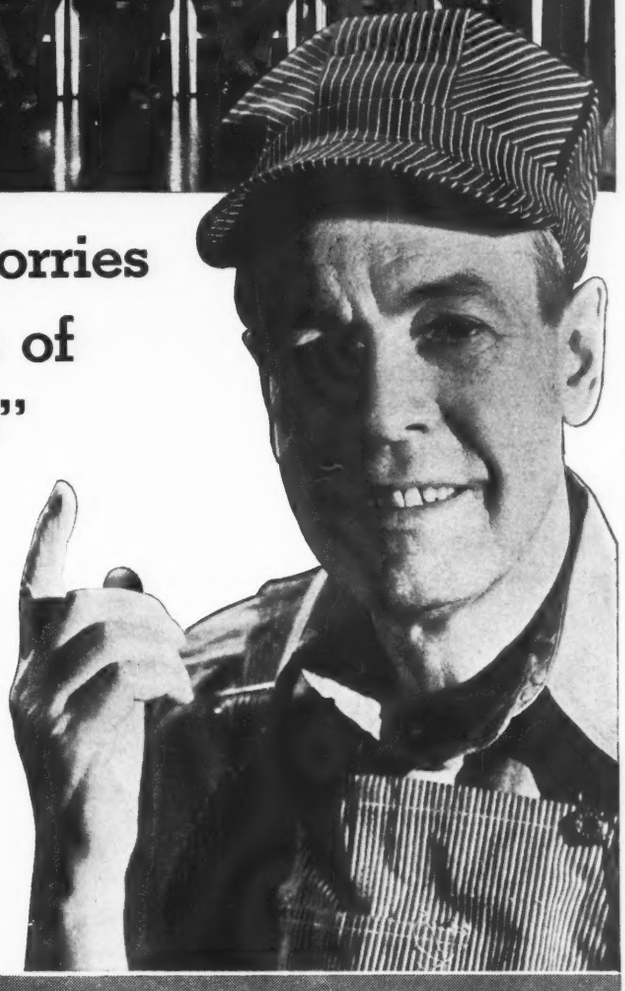
Danger Lurks in Steam Leaks

STEAM leaks in pipelines are generally objectionable because of the losses through them, but safety should have first consideration. Superheated steam is practically invisible when escaping and may seriously burn anyone getting into its path. The leak may be located by tying a rag on a stick and moving the former in the vicinity of the sound of the leak until the rag flutters.

A leak usually takes an irregular opening or path. As the steam changes direction of path at high velocity, there is considerable impact and scrubbing that causes abrasion and erosion, known as wire-drawing, that wears the opening larger at a rate depending on steam pressure, and quality and the hardness of the material. More serious may be the effect of long continued wire-drawing



"Put your Feedwater Worries on the broad shoulders of the Nalco Organization!"



MANPOWER

THE above picture shows the Nalco Industrial Department field organization with department and executive heads in a recent conference in Chicago. The vast wealth of practical experience and technical knowledge represented by such a gathering is not hard to visualize. To give all customers fullest benefit of such experience, it has long been Nalco's policy to maintain a continuous internal program for comparing notes and exchanging ideas. We will be glad to show you how this experience can benefit you also. NATIONAL ALUMINATE CORPORATION, 6222 W. 66th Place, Chicago, Illinois.

ANY WATER **NALCO SYSTEM** ANY PRESSURE

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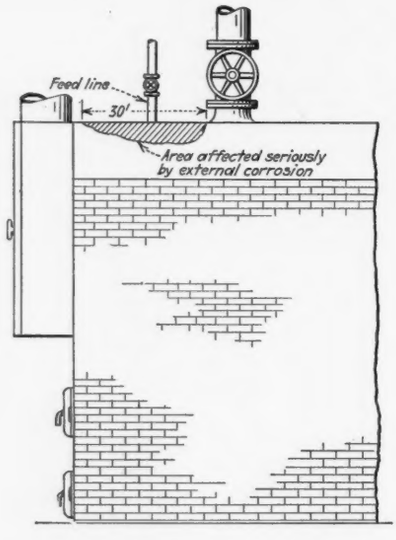
when a leaking gasket is neglected. Some time ago a fireman, possessed with much ambition and little experience, noticed steam leaking from a safety-valve-nozzle flange, and started tightening the nuts on the flange, with over 100-lb steam pressure in the boiler. The safety valve went through the roof with a roar, and the fireman was instantly killed. An investigation showed that leaking steam from the blown gasket had worn down two of the four $\frac{7}{8}$-in. bolts until less than $\frac{5}{16}$ in. remained. While this is a rather extreme case, it goes to emphasize the effect that a neglected steam leak may produce, and that no one



should tighten a flange under pressure.

A slight leak on the steam-gage piping, especially between the gage and the syphon, may blow out the water seal, and make the gage inaccurate by overheating. Possibilities for an accident are obvious if a pressure gage reads 50 lb when 150 lb exist in the boiler.

Leaks at a threaded connection may indicate nothing more than rough threads, or a poorly fitted connection. Continued leakage will ruin the threads by wire-drawing so that the joint cannot be made tight. On the other hand, leakage from a threaded connection can indicate a serious condition, a circumferential crack at the root of a thread. Here new pipe is the only proper cure.

Leakage from a water-column connection may not be serious to immediate safety of the pipe itself, but any flow from these connections causes false water-level indication. This is a dangerous condition and repairs should be made immediately.

External corrosion of a boiler shell or other parts may result from a leak, as shown in the figure, but this case was fortunately discovered before an explosion resulted. A slight steam leak was noticed coming through the brick covering on the top of the boiler. When sufficient covering was removed to expose the area around the leak, condition of the boiler shell was found to warrant an immediate shutdown. The feedwater pipe had been leaking slightly where it was threaded through the top of the boiler shell. Moisture in combination with sulphur-bearing soot produced sulphurous acid, and active external corrosion had been attacking the shell for probably several years, and reduced its thickness from $\frac{7}{16}$ in. to $\frac{3}{16}$ in. in the corroded area. This area extended more than 30 in. in a longitudinal direction, which was an extremely hazardous condition. This incident emphasizes the importance of carefully investigating all leaks, no matter how small.

Cleveland, O. A C Wiggins

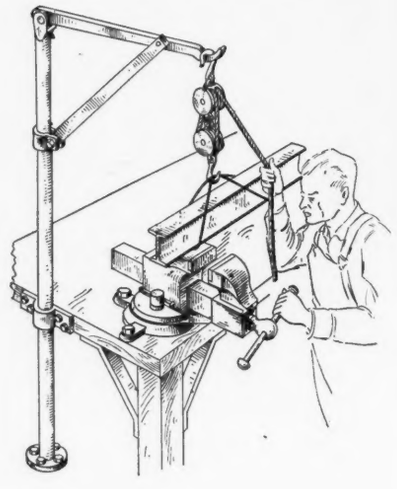
Pointers on Oil Burners

With about 350 different makes of oil burners in use in this country, there is bound to be some trouble in obtaining the kind of fuel oil best suited to a certain burner. The fuel-oil representative can tell you what can and cannot be done with the fuel oil he is able to ship to your tanks. The ability of a burner to handle any one of the fuel oils available depends upon its atomizing characteristics. If the oil is properly atomized, successful burning conditions will prevail. With excess smoke, over-all efficiency will decrease and higher steam costs may result from lower priced oils. In such cases, it is wise to use a better grade of oil.

Fuel-oil specifications are well established and the range available to the industrial user is confined to six. It is impractical to produce a grade which will fit precisely each of the 350 burners in use. Therefore, burner characteristics must be changed, and atomizing pressures developed to do the job. Many installations are being forced to do the impossible with air as the atomizing agent on air pressures ranging from 4 to 14 oz gage. The higher figure can be made to work successfully, but even 1 lb air may make the job much more satisfactory. Good preheating of the air will help as well as heating the oil to 150 F by heat exchangers.

Oil pressure, with the ordinary type of atomizing burner using air as the atomizing agent, need not be over 45 lb gage. Good results have been obtained with the circulating system, in which oil is kept going continuously through the distribution lines at high velocity. This prevents settling of heavy particles in the pipelines and cold pockets of oil. It also keeps the lines scoured out and the distribution system in good condition. In such systems, circulating lines should go right up to the burner instead of having a single pipe from the main to the burner. This single pipe or dead end, when the burner is not in use, fills with cold oil and develops starting troubles. Distribution piping should also be well covered to conserve heat in the oil.

Philadelphia, Pa. C C Herman



Bench Crane Handles Heavy Work

For convenient 1-man handling of heavy work, a simple jib crane shown in the figure will be found well worth the time and material required in its construction. The crane, shown in detail in the figure, should be at the end of the work bench where the shop's largest and heaviest bench vise should also be located.

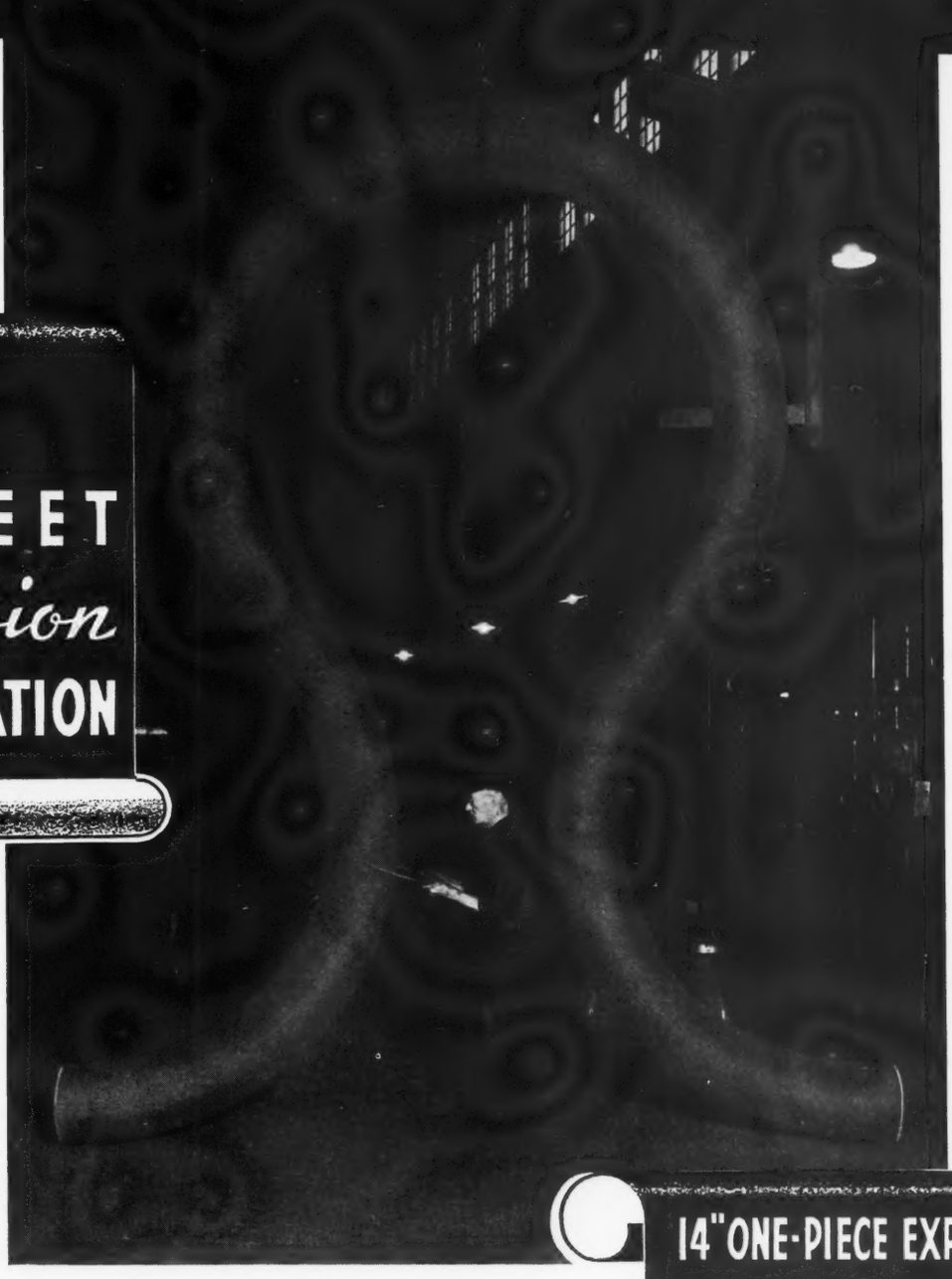
Penacook, N. H. C H Wiley

Emergency Diesel Plant Starts Automatically

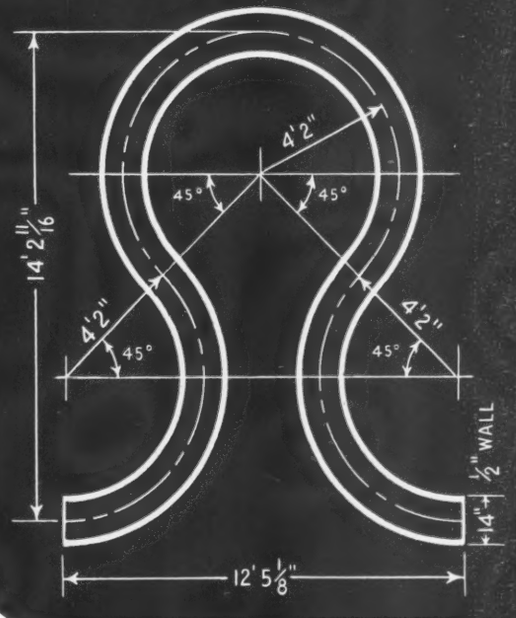
An interesting emergency diesel-electric power plant has been installed in the General Post Office at Berne, England. To insure continuity of power to important auxiliary apparatus and lighting at all times, the plant will start automatically if outside power supply fails. The plant comprises a 140-hp, 4-stroke diesel direct coupled to a 3-phase generator with direct-connected exciter. Starting is accomplished with compressed air supplied either from the engine compressor or from a separately driven unit. Air is stored in bottles filled after each start. Automatic-starting

40 FEET OF *Precision* PREFABRICATION

IN THIS ONE-PIECE EXPANSION BEND



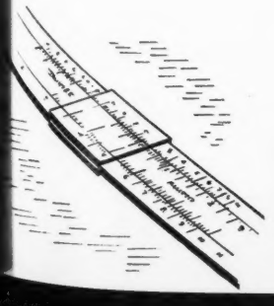
14" ONE-PIECE EXPANSION BEND



Instead of making a double offset U-expansion bend of this size in three pieces and welding them together on the job, this one, for a Texas refinery, was fabricated in one piece from a single 40' length of 14" x ½" wall thickness seamless pipe.

The fact that Pittsburgh Piping is located in the heart of the district that produces large pipe in the required length made possible the closest cooperation and supervision of the rolling of this unusual order.

The forming of the three bends exactly to specifications and the final machining of the ends to a tolerance of ±1/16" is a good example of what Pittsburgh Piping can accomplish in prefabricating the unusual.



PITTSBURGH PIPING & EQUIPMENT CO.
10 FORTY-THIRD ST. PITTSBURGH, PA.
BRANCH OFFICES & REPRESENTATIVES IN PRINCIPAL CITIES

Pittsburgh Piping

equipment includes an electrically driven auxiliary oil pump, the motor of which connects to a 60-volt battery of the telephone exchange. This pump discharges to a servomotor for operating the starting valves, and also to the cooling-water stop valve controlled by oil pressure.

When power-supply voltage falls to about half normal, a minimum-voltage relay starts the emergency plant, with a brief time lag, which may be adjusted between 0.5 and 2 seconds, unless the voltage has in the meantime returned to normal. A safety device connects the oil-pump motor to the battery, so that the pump starts and supplies oil to the engine bearings. At the same time, starting-servomotor control valve is closed by means of a motor-driven mechanism. As soon as the engine bearings are filled with oil, delivery oil pressure rises to a point at which the servomotor will start the engine. When engine speed approaches normal, the governor stops the oil pump and the starting-servomotor-control cock is brought back to its original position.

The starting operation takes about 10 seconds and the generator takes load in about 16 seconds from the time the power supply fails. As soon as the generator develops normal voltage, an automatic change-over switch functions unless normal power supply has been restored. The unit can be started by pushbutton so that the unit may be tested at any time.

C H S Tupholme

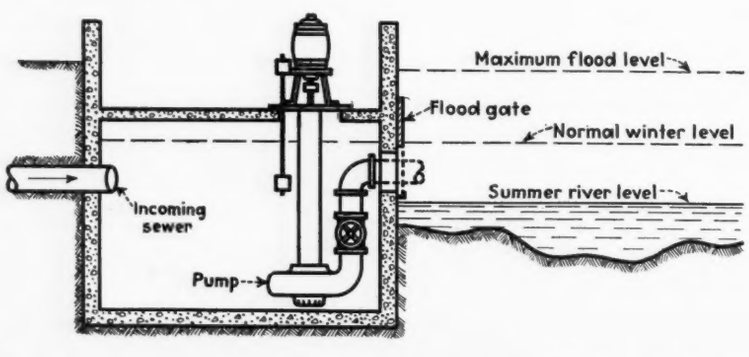
Farnham, England

Flood Gate Reduces Pumping Costs

Manufacturing plants situated on low ground adjoining a river have the problem of disposing economically of waste water from process, storm sewers and other sources. In some instances, gravity drainage is impossible because of seasonal variations in river level and pumps must be provided to lift the water from sumps to the river. Any scheme that reduces pumping power helps lower plant-operating costs.

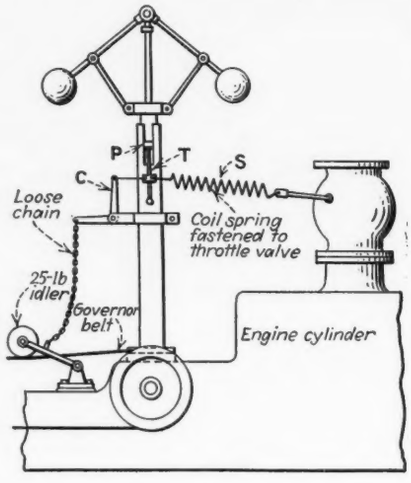
In one large plant, sewage-pumping costs are considerably reduced by taking advantage of varying river levels. As shown in the diagram, flood gates are provided in the sewage sump walls so that, whenever river level falls enough to allow gravity drainage, gates can be opened and the pumps shut down. In this installation, gates stay open about 160 days a year, which saves about 150,000 kwhr. This saving is particularly attractive in that it is made during the summer when power generation costs are at a maximum as turbines must be operated condensing to supply process electrical requirements.

Richmond, Va. C R Anderson



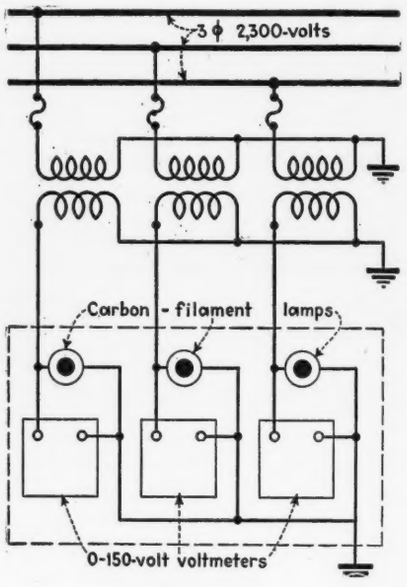
Automatic Stop Permits Overload

To stop an engine in event of governor-belt failure and at the same time to permit the engine to be overloaded, I developed the design shown in the figure. This equipment will allow the engine to be stalled by overload and not affect the automatic stop. Furthermore, the stop is not affected by low temperatures.



This automatic stop comprises a trigger *T*, held in place by a spring *S*, under a pin *P* in the governor-riser column. The trigger also attaches to one end of a 90-deg bell crank *C* supported on the governor post. A chain connects the other end of the crank to an idler riding on the governor belt. If the belt comes off or breaks, the idler pulley drops, pulls the trigger from under the pin and permits the governor to drop to its lowest position. If safety cams are properly set, the engine will stop.

Sloat, Calif. Roy T Brown

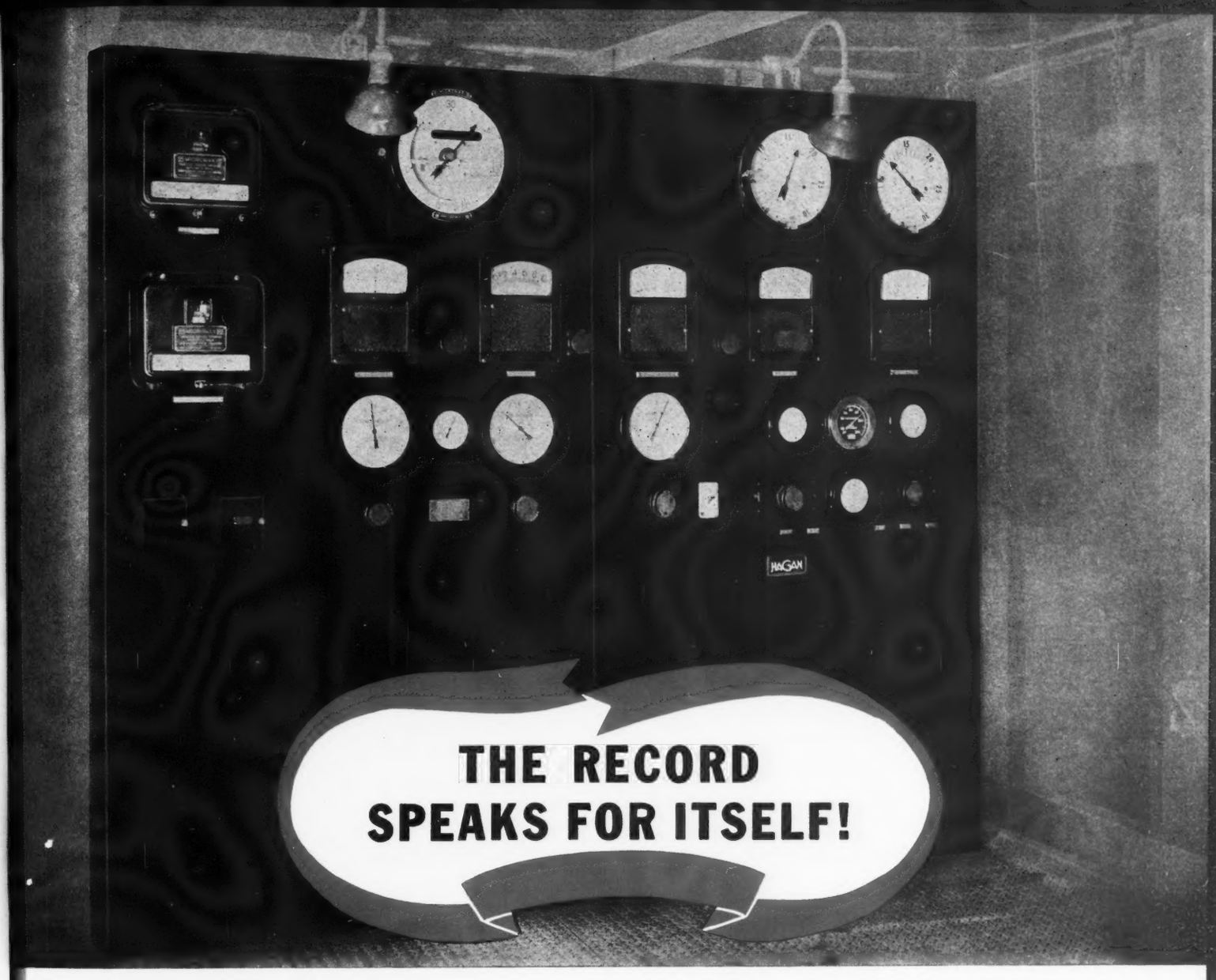


Three Voltmeters Serve as Ground Detectors

In remodeling switchgear of a moderate-size power plant, it was desirable to replace an old electrostatic ground detector. This instrument of comparatively crude construction did not invite confidence of the operators. A new ground detector shown in the figure has proved to be entirely satisfactory. The carbon-filament lamps give a visual indication that can be seen from any point in the engine room and the voltmeters indicate the severity of grounding. Absence of high-voltage leads to the instrument is desirable, because the instrument must be placed in the operating room where attendants are likely to come in contact with them.

Square-type voltmeters are differentiated from round instruments mounted on the rest of the board. Operators find the new set-up much more satisfactory and safe than the old instrument. In normal operation, lamps are lit and the voltmeters read approximately 70 volts. If a ground occurs, the lamp dims or goes out on the affected phase and the voltmeter indicates the degree of grounding on that phase.

Hibbing, Minn. A L Bennett



THE RECORD SPEAKS FOR ITSELF!

Hagan Automatic Control Panel for one of the three triple-fired slab heaters at the new J. & L. strip mill.

The new boiler equipment, new soaking pits and slab heating furnaces installed in connection with the new Jones & Laughlin continuous strip mill, are all equipped with Hagan Automatic Combustion Control. Let's look at the record!

In 1920, Hagan Control was installed on two new blast furnace gas-fired boilers at Eliza Works.

In 1930, increased power demands necessitated the installation of four 250,000 pounds per hour boilers, operating at 450 pounds pressure, fired with blast furnace gas and pulverized coal. Again Hagan Control was selected.

In 1936 a 400,000 pounds per hour boiler, fired with blast furnace gas and pulverized coal, was installed at Eliza Works to take care of the increased load requirements of the new strip mill. Again Hagan Control.

Fifteen new soaking pits were installed during the same year at South Side Works to heat ingots from which the slabs are rolled for the new strip mill. Proportioning of the air to the gas and regulation of furnace pressure on these pits is regulated by Hagan Control.

Also in 1936, three large triple fired slab heating furnaces were installed in connection with the new strip mill. Furnace pressure control, preheated air pressure control, and coke oven gas pressure control were supplied by Hagan Corporation.

This is another instance of Hagan's experience with old customers. Ninety per cent of them reorder. Why? Because they find by satisfying experience that Hagan Control is rugged, simple, fast, stable, and reliable. And above all that, it is not automatic **"in name only,"—it works automatically all of the time.**

At J. & L., Hagan Control is an important nerve center of this fine new mill. The record speaks for itself!

HAGAN COMBUSTION CONTROL

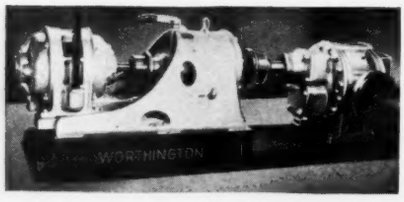
HAGAN CORPORATION

300 ROSS STREET, PITTSBURGH, PENNA.

What's New in Plant Equipment

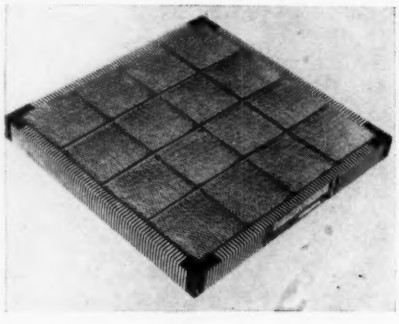
Pumping Unit

COMPACT pumping unit for bulk-transfer service where both thin and highly viscous liquids are handled. Herringbone-gear-impeller pump driven by constant-speed motor or internal-combustion engine through 2-speed enclosed transmission. For light liquids, pump may be operated at high speeds; for viscous



liquids, pump speed may be reduced. In either case, full power of prime mover is employed. In conventional applications of single pumping units, motors are selected for heaviest loads and are operated at a fraction of their rated power when pumping thinner liquids.

Worthington Pump & Machinery Corp, Harrison, N. J.



Air Filter

THROW-AWAY filter cleans air as it impinges against layers of expanded fibre. Layers have been sprayed with a sticky compound that retains dust and pollen. Three sections—a coarse, medium and fine mesh—make up complete filter. Each section consists of seven layers of expanded fibre. Efficiency ranges from 86% on up, depending on dust size. When filter is new, resistance to air flow at 250 fpm is 0.01 in. of water.

C F Burgess Laboratories, Inc, 110 W Monroe St, Chicago, Ill.

Fan Ventilator

"FREE-FLOW" ventilator made in three parts: base, head and fan barrel. Base and head are same as furnished in gravity ventilator with exception of additional stiffening in bases of larger sizes to support added weight of fan assembly. Fan barrel consists of section of round airshafting of sufficient length to house motor mounting, motor and fan.

Inspection doors on all fan barrels provide easy access to greasing connections. Special heat- and acid-resisting models for air temperatures over 105 F.

Burt Mfg Co, Akron, Ohio.

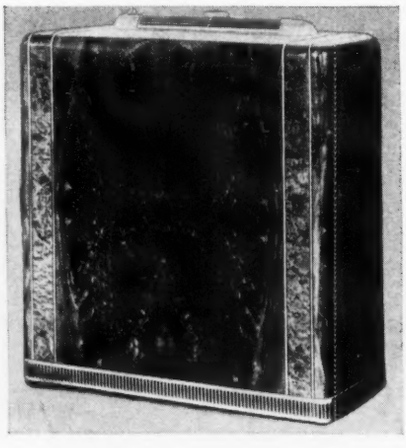
Carding Belt Hooks

NEW method of carding "Wiregrip" belt hooks said to keep each hook in exact position, speed loading of lacing machines, and prevent waste of short ends cut from cards of hooks. With this system of carding, desired number of hooks can be cut off easily with a pocket knife or scissors. No special tool required.

Armstrong-Bray & Co, 304-310 N Loomis St, Chicago, Ill.

Portable Conditioner

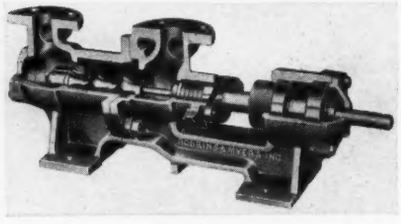
MODEL BA-90 "YORKAIRE" freon unit has adjustable rotary grille which diffuses conditioned air through room. Outside air is introduced through an adjustable damper. Both outside air and recirculated air are blended and passed through a special filter. Rapid room-air exhaust makes possible quick and thorough replacing of entire volume of air in room. Window adapter, adjustable to window size, contains fresh-air inlet, condenser-air intake, and condenser-air exhaust connections.



York Ice Machinery Corp, York, Pa.

Centrifugal Pump

"MOYNO" pump designed to combine self priming and high pressures of piston pump with uniform flow and valveless operation of centrifugal pump. Working elements are a stator, in which

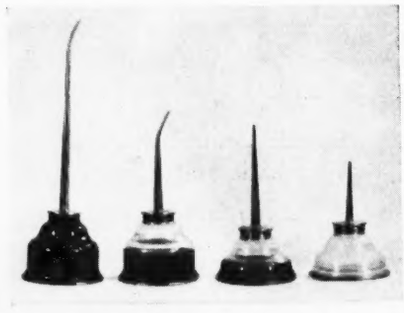


is molded an internal helix, and a spiraled and eccentric rotor, which rolls on the stator with hypo-cycloidal motion. Interaction of these two elements as rotor is revolved squeezes pump liquid ahead. Valves are unnecessary, as contact between rotor and stator seals pump against forward or backward flow of liquid. Is self-priming to within 1½ in. of mercury.

Robbins & Myers, Inc, Springfield, Ohio.

Oiling Can

"SCAN CAN" is molded from transparent, non-breakable plastic, not affected by oil, gasoline, etc. Heavy-gage copper-plated spout can be unscrewed from



body of can. Largest size ½ pint capacity. Weighs less than metal can of same capacity and user can see at any time how much oil is in can.

Universal Plastics Corp, 235 Jersey Ave, New Brunswick, N. J.

Automatic Proportioner

FOR automatically proportioning liquid and dry chemical reagents to an untreated fluid, this arrangement consists of a "Chronoflo" meter and venturi tube

This man can save you TIME *and* MONEY

● When a boiler goes down—when you're in a hurry for boiler tubes—call this man—your nearest ELECTRUNITE distributor. He's located in all principal cities. He carries complete stocks. Within a short time he will have the tubes you need on the way to you by the fastest means available. You'll save "down time"—which means money.

You'll save time and money, too, in installation cost—and you'll save money through the long service life of ELECTRUNITE. Accurate in size, uniform in diameter and wall thickness, highly ductile and with a fine scale-free surface free from rolled in slivers and other defects, these modern tubes offer advantages consistently found in no other tubes.

Write us for the complete story on ELECTRUNITE and the name of your nearest distributor.

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STEEL AND TUBES ELECTRIC WELD
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Steel and Tubes, *Inc.*
WORLD'S LARGEST PRODUCER OF ELECTRICALLY WELDED TUBING
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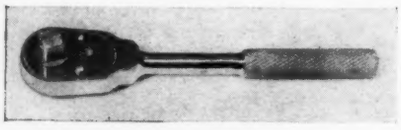
REPUBLIC STEEL CORPORATION

or orifice in main fluid line, controlling rate of feeding by electric signal. For liquid chemicals, this is done by positive displacement pumps, and for dry chemicals, by a vibratory dry feeder. Flow of main-line fluid through venturi tube produces a difference in elevation in levels of liquid in float pipes, one float pipe being connected to venturi-tube inlet and other to venturi throat. Floats actuate Chronoflo differential transmitter which sends out electric time-impulse signals. Floats are only used when pressure is 10 lb per sq in or less. For higher pressures, enclosed differential mercury receiver is used. In all cases, length of time signal which is sent out is proportional to rate of flow.

Proportioneers, Inc, 9 Codding St, Providence, R. I.

Ratchet Handle

REVERSIBLE ratchet handle, for ⅜-in. square-drive sockets and attachments, has ¼-in. square opening on other side of head for ¼-in. adapters or for small compressors, motors, shutoff valves.



Made of chrome-vanadium steel, chromium plated and highly polished.

Bonney Forge & Tool Works, Allentown, Pa.

Coal Crusher

TWO-ROLL spring-relief coal crusher has unbreakable all-welded steel framework and cut-tooth wheels. "Silverlink" roller chain drive to both rolls from crusher countershaft which is mounted in anti-friction bearings. Roll shafts are carried in heavy rigid bearings, with one shaft adjustable to vary size of product or to compensate for wear. Adjusting sleeves have relief springs as protection against excessive stresses, and any shock from these springs is transmitted directly to welded frame. Segmental rolls have cast-iron spiders to which are bolted heavy alloy-iron segments, heat treated to a Brinell hardness of from 500 to 600.

Link-Belt Co, 307 N Michigan Ave, Chicago, Ill.

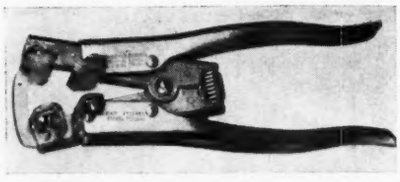
Close-Coupled Pump

TYPE H close-coupled centrifugal motor pump, for capacities up to 250 gpm and head up to 250 ft at speeds of 1750 and 3460 rpm, can be installed in any position. Is single suction, with single-stage enclosed bronze impeller. Adjustable bearing in outboard end of motor compensates for wear between pump clearance spaces. For portable and semi-portable operation as well as stationary. Bulletin A-01.

Gardner-Denver Co, Quincy, Ill.

Wire Stripper

AUTOMATIC stripper has lever which stops return of arms until wire is removed after stripping, then is snapped quickly back to normal. Protects operator's hands and prevents nicking, cutting



strands and waste of wire. Clamps, cuts insulation and automatically strips wire with one squeeze of handles.

Ideal Commutator Dresser Co, 1025 Park Ave, Sycamore, Ill.

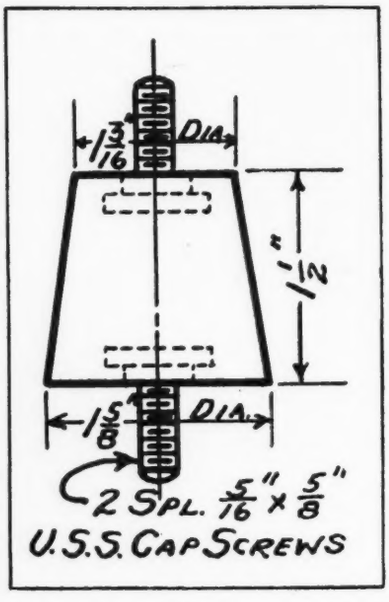
Fuel-Injection Units

RENEWABLE pumping units for Timken fuel-injection pumps are pre-metered at factory. Comprise a rigid, simple unit body, barrel and plunger, delivery valve and delivery-valve spring. Unit is held tightly in injection-pump housing by two hexagon nuts threaded on two studs in pump housing, pressing against a flange on upper end of pumping-unit body. Pumping unit is positively aligned axially in housing by close fit in housing bore and by reason of one of unit flange holes being accurately slotted to bear tightly on two sides of one dowel stud.

Timken Roller Bearing Co, Canton, Ohio.

Vibration Insulator

ADDITION to "Vibro-Insulator" line of rubber-to-metal mountings, Type 30 is made of a rubber compound having low permanent set. Loaded in shear, will carry load of 30 lbs; in compression,

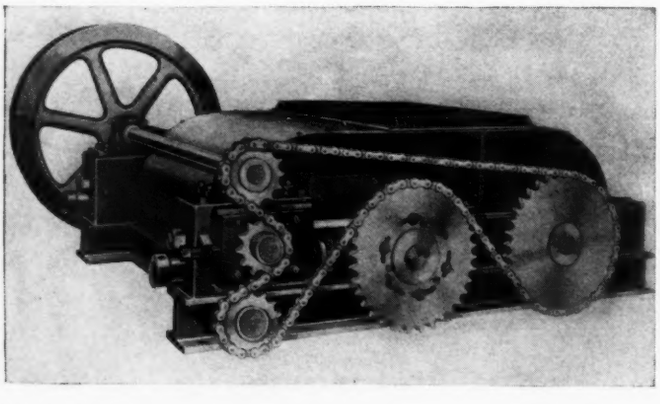


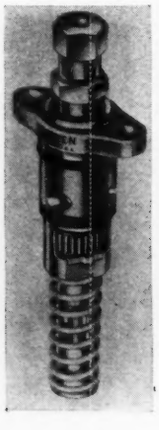
load of 120 lb. In either case, deflection is 3/8 in, providing for a minimum machine frequency of 925 per min. For mounting air compressors, refrigerating units, etc.

B F Goodrich Co, Akron, Ohio

Industrial Heaters

FORCED-CONVECTION heater made in three sizes: small portable in ratings of 2, 3 and 4 kw; intermediate size, suspension style, in ratings of 5 and 7½ kw; and suspension heater in ratings of 10, 12½ and 15 kw. 230 volts, 60 cycles—small and intermediate sizes are single-phase;





Can ANY "SURFACE-MOTOR" PUMP GIVE YOU THESE

SUBMERSIBLE MOTOR ADVANTAGES

ENTIRE UNIT —PUMP AND MOTOR— OPERATES SUBMERGED IN WELL OF ANY DEPTH
NOTHING ABOVE GROUND BUT DISCHARGE ELBOW AND WEATHER-PROOF SWITCHBOX
CAPABLE OF YEARS OF CONTINUOUS DEEPWELL SERVICE WITHOUT ATTENTION

THE short-coupled motor and pump operate as a unit, completely submerged in water. Long shaft and resulting power losses are eliminated. No pump house or other surface equipment required. Weather-proof switchbox and controls (automatic or manual) can be located at any point desired. Entire unit completely assembled and tested at factory; no field assembly or adjustment required at installation. Oil, when needed, is added to the sealed motor from the surface.

These are just the high lights. In *any* deepwell service the SUBMERSIBLE will give you water-lifting economy never before obtainable. Many SUBMERSIBLES installed more than five years ago are giving uninterrupted service—without inspection, repair, or renewal or addition of oil.

FIND OUT WHY . . .
the SUBMERSIBLE is ideal for pumping from crooked wells; why the motor cannot overheat or run dry of oil; why it costs less to install, operate and maintain. Mail the coupon or write today for full information and large cross-section drawing.

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Deepwell Turbine Pump

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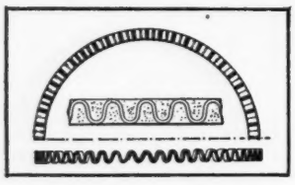
CENTRIFUGAL PUMPS FOR EVERY SERVICE

large size, 3-phase. Calrod heating units are brazed to radiating fins. Totally enclosed motor has sleeve bearings and a baffle plate to protect it from overheating.

General Electric Co, Schenectady, N.Y.

Piston Ring

ONE-PIECE ring is made of resilient corrugated metal strip bent into a circle. Plastic material, molded into body metal, acts as a filler, completely filling piston-ring groove. Filler and body form

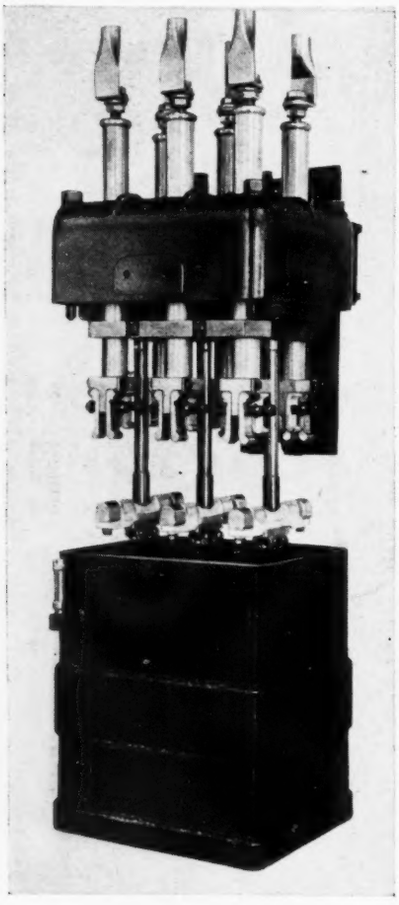


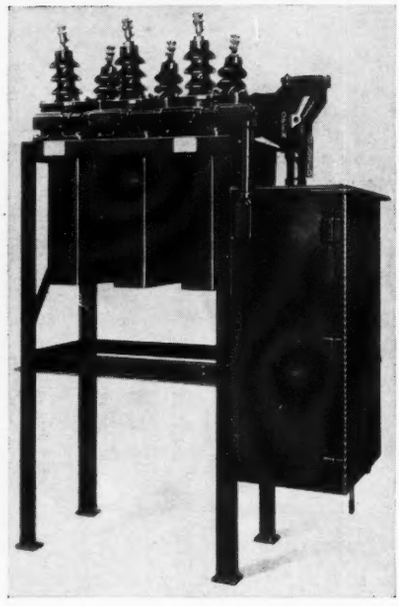
a solid integral open band which is wrapped around piston-ring groove. Varying alloy of metal, or number of corrugations per inch, or metal thickness, makes possible any wall tension.

Elk Machine & Tool Works, 109 W 64th St, New York, N. Y.

Circuit Breakers

FIRST photo shows Type DX-24 moderate capacity indoor oil-circuit breaker. Expulsion ports are claimed to hasten arc extinction. Self-aligning, wedge-and-finger contact with silver surfaces on main contacts; cast-steel top frame,





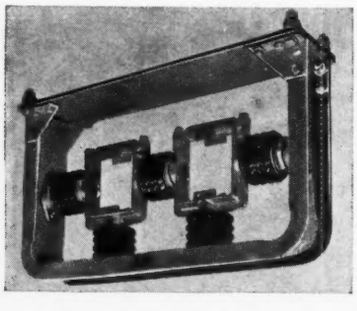
electrically welded steel tank; flat angle, straight-line-motion mechanism. Manually or electrically operated for 600, 1200 and 2000 amps at 15,000, 7500, and 5000 volts respectively. Interrupting capacity rating of 75,000 kva.

Second photo shows Type OZ-110 moderate capacity outdoor oil-circuit breaker. Special interrupting "Ruptors" give quick clearing of short circuits, and unit has low arc energy, low pressure, and minimum oil deterioration. For 600 amp at 15 kv, with interrupting capacity rating of 100,000 kva. Arranged pole or frame mounting.

Allis-Chalmers Mfg Co, Condit Works, Boston, Mass.

Bus Support

Two sets of twelve 6x¼-in. bars, with wide spacings between groups of six, are carried on wet-process insulators in compression. Clamps, with rollers and springs, permit bus expansion and con-

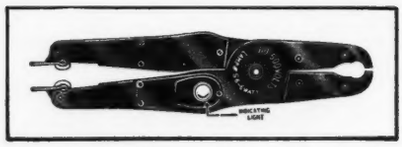


traction. Steel frame is held on bottom of floor beams by 5/8-in. bolts and beam grips. Adjusting nuts between frame and end insulators insure rigidity of supports without resorting to spacers.

Delta-Star Electric Co, 2400 Fulton St, Chicago, Ill.

Test Pliers

INSULATED test pliers, for 110 to 600 volts, has removable tungsten lamp. This instrument locates dead circuit,

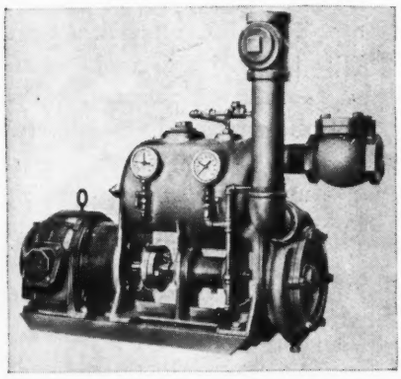


and then can be used to remove blown fuse. Prongs on grip end of pliers test base receptacles.

Star Fuse Co, Inc, 235 Canal St, New York, N. Y.

Self-Priming Pump

"AUTO-PUMP" combines in a compact unit pump and priming tank adaptable to full automatic control. Only part of air handled during priming period passes through pump; greater part is

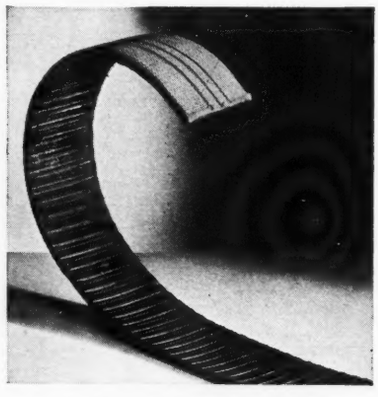


expelled from priming tank directly into discharge line. Once primed, pump will hold its prime for days. Made in six sizes ranging from 1 to 15 hp, 1800 and 3600 rpm.

Barrett, Haentjens & Co, Hazleton, Pa.

Leather Belting

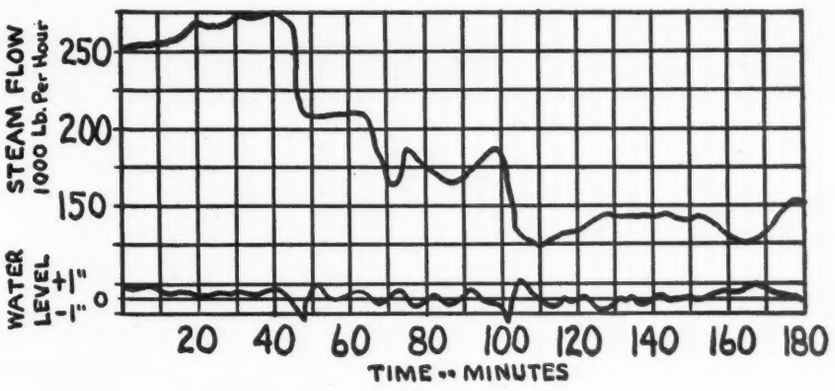
BELT face is made of imported-chrome leather. Since its cost, when new, is prohibitive for belting, the maker uses leather reclaimed from industrial purposes which, by taking stretch out of the leather, is claimed to improve its



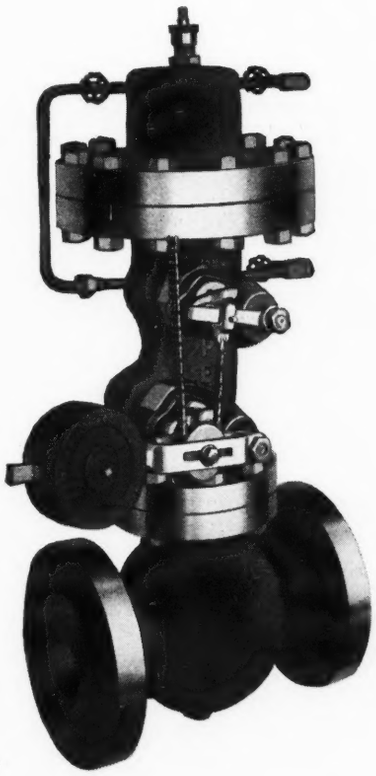
quality as belting. Use of soft leather in belting is made possible by strong backing of special impregnated fabric.

Sudbury Laboratory, P.O. Box 976, South Sudbury, Mass.

(Continued on page 138)



Charts prove value of steam-flow type COPES *feed water control*



Plant: prominent utility. Boiler: 800-pound pressure cross-drum. Firing: pulverized coal. Load: between 275,000 and 125,000 pounds per hour. Water level: held within plus or minus 1.5 inches. Feed water regulator: the new COPES Flowmatic, a simplified steam-flow type. Ideal for your high-pressure, high-rating boilers. Write for descriptive Bulletin 409-A.

NORTHERN EQUIPMENT CO., 311 GROVE DRIVE, ERIE, PA.
Feed Water Regulators, Pump Governors, Differential Valves, Liquid Level Controls, Reducing Valves and Desuperheaters.
BRANCH PLANTS IN CANADA, ENGLAND, FRANCE, GERMANY, AUSTRIA AND ITALY. REPRESENTATIVES EVERYWHERE.

Get closer boiler water level control with the new

COPES

FEEDS BOILER ACCORDING TO STEAM FLOW•AUTOMATICALLY

FLOWMATIC

★ REGULATOR

Engineers' Books

Power Plants

CENTRAL STATIONS (1937)—*By Terrell Croft and George H Hall. Published by McGraw-Hill Book Co, 330 West 42nd St, New York, N. Y. 360 pages, 5x8 in., 285 illustrations. Price $3.00.*

The third edition of this practical book on generation, transmission and distribution of electrical energy contains new material relating to turbines, network systems and lightning-protective apparatus.

The book has been brought up to date without departing from the original practical presentation. It presents material on demand factors, diversity factor and plant factor in everyday language that can be understood without complex mathematics.

Tables

SEGMENTAL FUNCTIONS (1937)—*Text and Tables by C K Smoley. Published by C K Smoley and Sons, Scranton, Pa. Price $5.00.*

Five-place log tables of functions of the elements of circular segments in form for ready application to the solution for arc, chord, radius, central angle and height of segments. Tables are preceded by explanatory text and other tables of areas and squares useful in calculation of properties of segments. For designing engineers.

Graphical Computation

HOW TO MAKE ALIGNMENT CHARTS (1937)—*By M G VanVoorhis. Published by McGraw-Hill Book Co, 330 West 42nd St, New York, N. Y. 114 pages, 6x9 in., 78 charts and diagrams. Price $2.50.*

This book gives direct instructions on how to construct alignment charts for engineering formulas. Construction of charts is illustrated as much as possible with a minimum of text. Theory is separated from construction in an appendix. A knowledge of plane geometry and algebra is required for complete understanding of the methods used, but mathematical presentation is avoided. A good book for home study of chart making.

Air Conditioning

AIR CONDITIONING IN WINTER AND SUMMER (1938)—*By Richard E Holmes, Design Engineer, Westinghouse Electric & Mfg Co. Published by McGraw-Hill Book Co, 330 West 42nd Street, New York. 287 pages, 6x9 in., price $3.00.*

Based on courses given by the author to students employed in or preparing for the air-conditioning industry, this book assumes that the reader has no previous knowledge of the subject and presents a comprehensive treatment of its major phases. Two chapters are devoted to a clear discussion of the fundamental properties of air and a third to the consideration of comfort requirements.

Other chapters cover air-conditioning systems, winter and summer load, types of equipment, applications of equipment, and controls. It is well illustrated with views of modern equipment, mostly small or medium size units, and the simple, direct presentation commends it to the man who wants to learn first principles.

World Power

STATISTICAL YEARBOOK OF THE WORLD POWER CONFERENCE, No 2 (1937)—*Edited, with introduction and explanatory text, by Frederick S Brown. Published by The Central Office, World Power Conference, 36 Kingsway, London, W C 2, England. Price in the United States, including mailing, $5.00. Orders may be placed at London or through American National Committee of the World Power Conference, Interior Building, North, Washington, D. C.*

Statistics on resources of solid, liquid and gaseous fuels, and waterpower resources, classified by continents and countries, are given in this yearbook, as well as figures on the annual production of fuels and water power. Also included are statistics on production of electricity, classified by countries, and broken down to show the proportions generated by each type of prime mover. Separate tables give the production of electricity in various countries by various types of industries. The data is carefully annotated and sources are given. The period covered is 1934, 1935.

BRIEF REVIEWS

RESULTS OF MUNICIPAL LIGHTING PLANTS (1937)—*Published by Burns & McDonell Engrg Co, 107 W Lindwood Blvd, Kansas City, Mo. Price $2.00*—This 230-page volume covers 511 municipal power plants in representative cities, their rates, earnings, operating expenses, profits, kwhr production, etc.

REPORT OF THE RESEARCH AND EXTENSION ACTIVITIES, (1936-37). *Free from Engineering Experiment Station, Purdue University, Lafayette, Ind.*—Yearly report on record of researches carried out in cooperation with the several engineering schools and departments.

FOR MODELMAKERS. *Bound Vol. 14 (Oct 1936-Sept, 1937) of* THE MODELMAKER. *Published by the Modelmaker Corp, Wauwatosa Wis. 167 pages. Price $2.00*—A nice little book for engineers who like to tinker around in home workshops. Lots of power stuff, including operating miniatures of locomotives, steam turbines, motor boats, flash boiler, gas engine, Corliss, old walking-beam engine, and high-speed steam engine.

17TH ANNUAL REPORT OF THE FEDERAL POWER COMMISSION (1937). *For sale by Supt of Documents, Washington, D. C. Price 10 cents*—Includes work of the commission and its major activities, rate studies, need for increased generating capacity, costs, trends, etc.

HOW TO HANDLE GRIEVANCES. *By Glenn Gardiner. Published by Elliott Service Co, 219 E 44th St, New York, N. Y. Price 60 cents, leatherette binding; 40 cents, paper binding (less for quantity orders)*—A booklet for managers, executives, foremen, etc, showing how to forestall and anticipate labor grievances and to prevent small grievances and misunderstandings from growing into serious complaints.

HANDBOOK OF CHEMISTRY & PHYSICS (22ND EDITION). *Published by Chemical Rubber Publishing Co, 1900 W 112th St, Cleveland, Ohio. 2090 pages, price $6.00*—Latest edition of the well-known handbook contains chemical-engineering data condensed in one volume.

ELECTRICAL YEAR BOOK (1938). *Published by Emmott & Co, Ltd, 31 King St West, Manchester 3, England. Price 1 shilling, 6 pence (about 40 cents)*—In addition to general revision this year, particular attention has been given to power generation and distribution. New information is given on phase sequence, symetrical components, leakage protection, distance protection and ac-motor protection.

MECHANICAL WORLD YEAR BOOK (1938). *Published by Emmott & Co, Ltd, 31 King St West, Manchester 3, England. Price approximately 40 cents*—This edition includes a new section on welding, giving processes, design and directions, plus the usual sections on mechanical transmission, power generation, etc.

KEMPES ENGINEER'S YEAR BOOK (1938). *Published by Morgan Bros, Ltd, 28 Essex St, Strand, London, England. 2800 pages, price 31/6 (about $8.00)*—The 44th edition of a volume that covers all phases of engineering. Revised and brought up to date.

SYMPOSIUM ON THE SIGNIFICANCE OF TESTS OF COAL—*132-page booklet reprinted from the Proceedings of the ASTM contains six technical papers, by Gould, Kreisinger, Gauger and others. Obtaintable from ASTM headquarters, 260 S Broad St, Philadelphia, Pa., at $1*—The articles cover coal testing, ash-softening temperature, sulphur content, properties of bituminous coal, friability, and pulverizer performance. A bibliography is included.

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$27 YOU CAN START A TESTING SET

ONE AP-9 voltmeter, net price only $27, can form the basis for your testing set. With this single instrument you can begin to capitalize the many ways in which instruments may point the way to savings. It's a simple, inexpensive way to turn power losses into power savings.

The AP-9 is a handy instrument. Compact, like a modern camera, it's easy for the service man to carry and use. It's built to stand up under hard usage. The accuracy is ¾ of one per cent of full-scale value—high enough for almost every commercial testing job. You'll find many uses for the AP-9 voltmeter in your plant.

Later, when you have begun to realize the savings these instruments make possible, you can increase your testing facilities with others from the AP-9 line—ammeters, milliammeters, and wattmeters. Start your testing set now. Call the nearest G-E sales office today. General Electric, Schenectady, New York.

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HEADQUARTERS FOR ELECTRICAL MEASUREMENT

430-100

Priceless Ingredient . . .

Once I had to make a 2-minute talk. "Well," I thought, "that's simple. I can dash that off in no time!" I tried it. I put down the things I wanted to say—it made a swell half-hour speech. Then I remembered an old saying of Fred Low's "Take time to be brief." I went at it again. Fifteen rewrites, with every word I cut out a drop of my heart's blood, and I finally had it to two minutes. My fifteenth draft was about ten times as clear as the first, *and had just as many ideas.* If I had used the original, my haste would have been my listeners' waste—they'd have spent 30 minutes to get two minutes worth of facts.

Fred Low knew that his basic job was to save his readers' time, so he insisted that his editors make their articles clear and concise. Such a policy is expensive. It takes more manpower because an editor spends a lot more time on a given article and it ends up a half or a third its original length. But how the "idea concentration" does go up! There's a lot more meat to the square inch.

And that additional working-over time means a saving of half the reading time of 25,000 subscribers, and about four times as many actual readers. That's worth brevity!

Fred Low followed his own orders. So hundreds of us helped by his words still remember him. His magazine continues his policies—look at the present Special Sections. They prove again that you can be more exact, more complete, more clear, in less space—if you only remember what a famous surgeon said, "A man will bleed to death from a severed carotid artery in three minutes. You can tie this artery in two minutes, *if you are not in a hurry.*"

The most priceless ingredient in any man's life is his time. Once gone, it can never be replaced. No man can create it; he can only save time by using it, or waste it by "killing" it. His advisers can help him most by being to the point as *Power's* editors are. Let me then, as an outsider, offer these few words of appreciation for the time they have saved me, by giving me the same data in 300 words that I might have had to read a thousand for elsewhere.

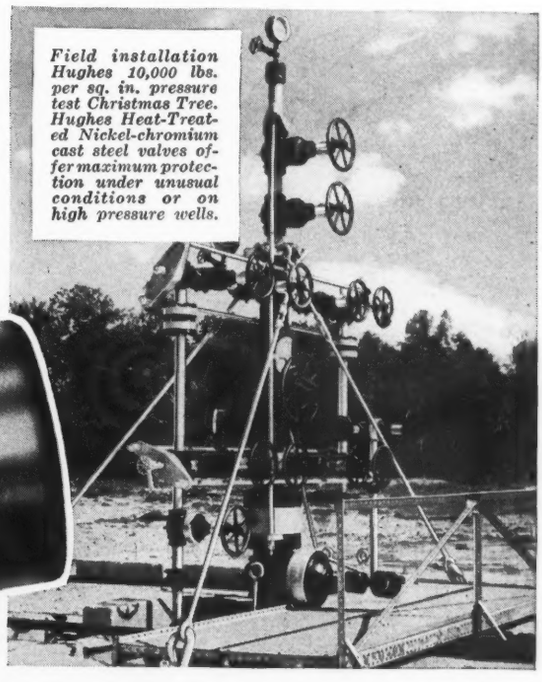
George Edwards

Engineer

SAFE AT TWICE THE PRESSURE

This Hughes Nickel-chromium Cast Steel 10,000 lbs. per sq. in. pressure test valve held up to 28,500 lbs. per sq. in. in a "Destruction" test

10,000 lbs. per sq. in. pressure test Manifold Valve manufactured by Hughes Tool Co., Houston, Tex. Hughes 10,000 lbs. per sq. in. test valves are available in either screwed or flanged ends.



Field installation Hughes 10,000 lbs. per sq. in. pressure test Christmas Tree. Hughes Heat-Treated Nickel-chromium cast steel valves offer maximum protection under unusual conditions or on high pressure wells.

Increased strength and safety, you'll agree, are essential in controlling well pressures stepped up in recent years from 1,000 to 3,000 to 5,000 lbs. per sq. in. And every step of the way, increased strength and safety have been built into Hughes high pressure valves and fittings.

For example, in keeping with a 25 year old policy of *anticipating* the needs of the Oil Producing Industry, Hughes valves are now tested to 10,000 lbs. per sq. in. for 5,000 lbs. working pressure. And to allow an ample factor of safety these valves are cast of Nickel-chromium steel. Does this alloy furnish the required strength? Note the "Destruction" test data – and the analysis and properties of cast Nickel-chromium steel:

There is no guesswork about Hughes Valves withstanding High Pressure. Hughes Tool Company finds out how much they will stand by means of perodical "Destructive" Tests conducted in this special chamber. An unusual and effective phase of the Engineering and Development Laboratory work.

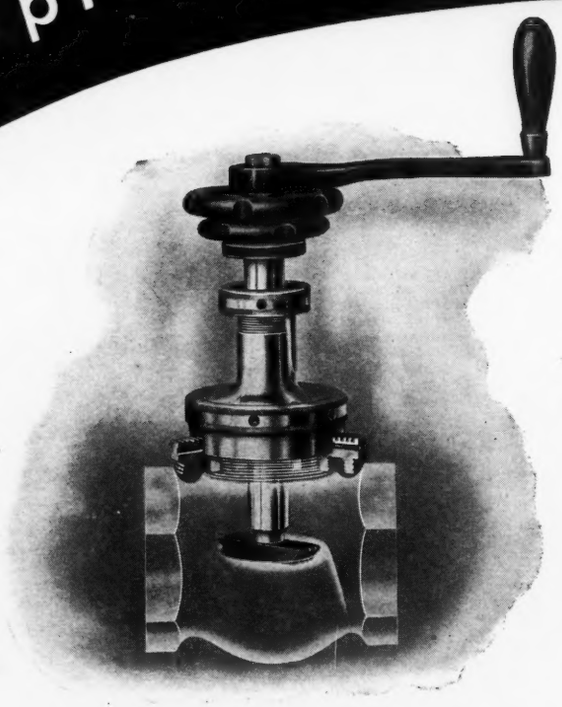
ANALYSIS		PHYSICAL PROPERTIES
Carbon	0.32%	(After heat treatment)
Manganese	0.75%	Tensile strength, 100,000 psi.
Phosphorus	0.025%	Yield point, 65,000 psi.
Sulphur	0.035%	Elongation in 2", 22.5%
Nickel	1.50%	Reduction of area, 40.0%
Chromium	0.40%	Izod impact, 45 ft. lbs.

Increased density and uniformity of grain structure results from alloying steel with Nickel. Increased strength—and a substantial factor of safety at high pressures—is assured. Consultation pertaining to high pressure castings is invited. Please address:

NICKEL CAST STEEL

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.

Why pay for Valve Replacements?



Use the

DEXTER GLOBE VALVE RESEATING MACHINE

- **RESEAT VALVES IN PLACE**
- **NO PIPE DISCONNECTING**
- **STOPS LEAKING**

The valves are reseated in place—no disconnecting piping. The job is quickly done. Both seat and disc are refaced making a perfectly tight seating valve.

The valves are reseated as soon as found leaking. Saves new valves. Less labor. Reduces wasted steam and water caused by leaking valves to a minimum. Made in valve capacities from 1/4" to 12" inclusive.

The cost is small in comparison with the savings. Write for Catalog No. 24 which describes Dexter Machines for Reseating Globe Valves, Gate Valves, and Pump Valve Seats.

(ALSO MANUFACTURERS OF THE SWENDEMAN AUTOMATIC SEPARATOR)

THE LEAVITT MACHINE CO.

10 East River St. Orange, Mass.

NEW BULLETINS

BOILERS & ACCESSORIES

1 CONDENSER TUBES—Condenser Service & Engineering Co, 310 12th St, Hoboken, N. J. 4-page bulletin describes several cases in which use of patented "Air and Erosion Eliminator" has increased life of condenser tubes.

2 CORROSION CONTROL—D W Haering & Co, Inc, 3408 Monroe St, Chicago, Ill. 2nd edition of "Organic Methods of Scale and Corrosion Control" discusses and describes principles and applications of organic chemistry. Many charts and graphs. 16 pages.

3 PROPORTIONING—D W Haering & Co, Inc, 3408 Monroe St, Chicago, Ill. 24-page catalog, "The Art of Proportioning", describes operation, construction and application of H-O-H feeders operated by pressure difference between pitot tubes employing fluid-piston principle.

4 BLOWOFF VALVES—Hancock Valve Div, Manning, Maxwell & Moore, Bridgeport, Conn. 4-page bulletin No. 8500 describes new blowoff valve with "Blo-Deflector" protecting lip that acts against wear and leakage.

5 TILE CONDUIT — American District Steam Co, N Tonowanda, N. Y. Revised 2-color, 8-page bulletin No. 35-67A on tile conduit and filler insulation for underground steam or hot-water lines, includes illustrations, details of construction and applications.

6 HEATERS—Alberger Heater Co, 281-89 Chicago St, Buffalo, N. Y. 36-page Bulletin 200 gives specifications, construction and operating details on instantaneous heaters, feedwater heaters, storage heaters, heat exchangers, vapor condensers, etc. Well illustrated with line drawings and photographs.

PUMPS & COMPRESSORS

7 AIR COMPRESSORS — Ingersoll-Rand Co, 11 Broadway, New York, N. Y. Catalog 3426 covers developments and refinements accomplished over past 30 years in manufacture of direct-connected, synchronous-motor-driven compressors. 20 of 56 pages cover 50 representative installations in all parts of the world.

8 CENTRIFUGAL PUMPS—Morris Machine Works. Baldwinsville, N. Y. Bulletin 167 on "Morris Straightflo Pump", a centrifugal unit for handling large capacities at low heads, shows exterior views, sectional drawings, and dimensions of both horizontal and vertical types.

9 INDUSTRIAL COMPRESSORS AND VACUUM PUMPS—Ingersoll-Rand Co, 11 Broadway, New York, N. Y. Folder bulletin No. 2118, on small compressors and vacuum pumps ranging in size from 1/4 to 15 hp, gives complete rating tables of more than 50 models, including physical dimensions, capacities, pressures, and rated hp.

HEATING, VENTILATING & AIR CONDITIONING

10 ROTARY VENTILATORS—Swartwout Co. 18511 Euclid Ave. Cleveland, Ohio. Bulletin 205 describes construction and operation of rotary roof ventilators. Also contains data showing how to figure capacity, lists heat and temperature factors, and wind-velocity factors. Page table shows average wind velocities for 61 U. S. cities.

11 WROUGHT IRON—A M Byers Co, Pittsburgh, Pa. In 28 pages, "Wrought Iron in Refrigerating and Air-Conditioning Systems", discusses corrosive conditions encountered in various types of refrigeration, air-conditioning and ice-skating-rink equipment, and suggests an economical solution to the problem of durability.

As one refinery superintendent put it, "Our men have always looked up to Midwest Piping. They find that when we buy piping from Midwest, it goes into place easier and faster . . . the bends, joints and welded sub-assemblies always are workmanlike jobs."

Many engineers responsible for power plant and industrial process piping have similarly expressed themselves.

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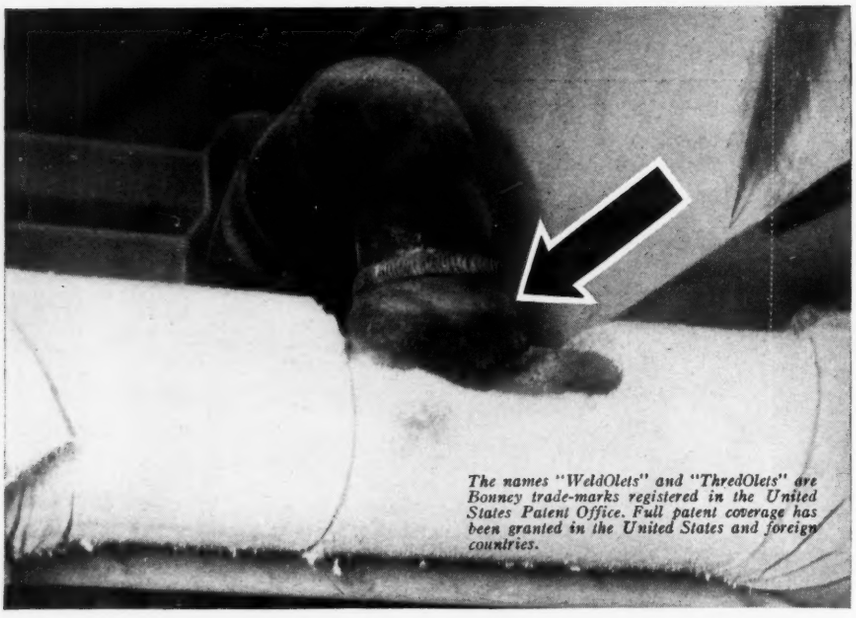
Main Office: 1450 So. Second St., St. Louis, Mo.

Plants: St. Louis, Passaic (N. J.) and Los Angeles • Sales Offices: Chicago—946 Marquette Bldg. • Houston—1716 Second National Bank Bldg. • Los Angeles—580 Anderson St. • New York—(Eastern Division) 30 Church St. • Tulsa—933 Mayo Bldg.



The names "WeldOlets" and "ThredOlets" are Bonney trade-marks registered in the United States Patent Office. Full patent coverage has been granted in the United States and foreign countries.

For Branch Pipe Connections

BONNEY WELDOLETS·THREDOLETS

WELDING has become the accepted method of making piping installations, and WeldOlets and ThredOlets are the accepted fittings for making branch pipe connections by welding.

Branch outlets made with WeldOlets and ThredOlets are strong, permanent and absolutely leak-proof. All cutting, threading and fitting of the main pipe is eliminated. Preliminary layouts of the main pipe are unnecessary. No templets are used.

The funnel shaped outlets of WeldOlets and ThredOlets provide free, unrestricted flow. Their heavy, external rib compensates for loss of strength in the main pipe when the hole is cut, and distortion is entirely eliminated.

Available from stock in size-to-size or reducing sizes from ½" to 12". They are as adaptable to maintenance work as to new construction, whether indoors or out, above or below ground. Standard fittings are of drop-forged steel, but for special applications they can be supplied in Wrought Iron, Toncan Iron, brass, Monel, Everdur, in fact in any metal that can be forged.

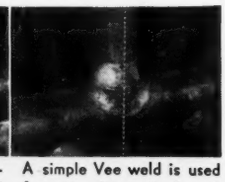
Bulletin WT23 tells all about them. Write for your copy today.

They are easily installed!

WeldOlets and ThredOlets are quickly and easily installed. Select the position of the outlet anywhere on the main pipe, mark center lines and tack the fitting into position.

Then weld by electric-arc or oxy-acetylene method. A leak-proof joint of full pipe strength is obtained.

On two-inch outlets or larger the button is removed after installation. A full inspection of the inside of the joint is possible when WeldOlets and ThredOlets are used.



A simple Vee weld is used for attaching the branch when WeldOlets are used. If ThredOlets are used, the branch is screwed into position.

BONNEY FORGE & TOOL WORKS, Allentown, Pa.
WELDOLETS·THREDOLETS
. . . *Welded Outlets for Piping* . . .
Stocked by Leading Distributors

ELECTRICAL EQUIPMENT

12 WIRE AND CABLE—U S Rubber Products, Mechanical Goods Div, 1790 Broadway, New York, N. Y. Illustrated wire manual is designed to provide electrical engineers, contractors, etc, with wire and cable data and specifications.

13 GENERATORS—Westinghouse Electric & Mfg Co, E Pittsburgh, Pa. "AC Generators for Diesel-Engine Drive", a 16-page illustrated booklet, covers installations of generators connected to many styles of diesels and construction details of electrical and mechanical parts.

14 ASBESTOS-INSULATED WIRES AND CABLES—General Electric Co, Bridgeport, Conn. Bulletin on "Deltabeston" power cable, control cable, motor-lead cable and boiler-room wire. Covers in detail processing and application of purified asbestos. Data and tables for specifying and ordering.

15 SWITCHGEAR — Delta-Star Electric Co, 2400 Fulton St, Chicago, Ill. 40-page illustrated bulletin No. 66 covers metal-clad switchgear, cubicle switchgear, switch houses, switchboards.

OTHER EQUIPMENT

16 NEOPRENE—E I Du Pont de Nemours & Co, Wilmington, Del. Vol. 1, No. 1 of "Neoprene Notebook" gives engineering information, laboratory data, and application reports on neoprene.

17 BEARINGS—New Departure Div, General Motors Corp, Bristol, Conn. 20-page booklet R25 contains numerically arranged lists of competitive ball bearings, together with corresponding numbers of interchangeable New Departure bearings. Also has alphabetically-arranged definitions of letter combinations used by various manufacturers to identify bearing characteristics.

18 LUBRICATING-OIL COOLER—Griscom-Russell Co, 285 Madison Ave, New York, N. Y. Leaflet 710 covers construction and application of "G-R Multiwhirl Cooler" for turbine and diesel lubricating oil, jacket water from diesel engines, quenching oil, transformer oil, etc.

19 BEARINGS—Shafer Bearing Corp, 35 E Wacker Drive, Chicago, Ill. 74-page catalog No. 14 describes and lists complete line of radial-thrust roller bearings, and self-aligning and roller-bearing units.

20 BELTING AND HOSE—Cincinnati Rubber Mfg Co, Cincinnati, Ohio. 48-page illustrated catalog covers construction and application of transmission belting; conveyor and elevator belts; air, water, acid and steam hose; tubing, packings, gaskets, etc. Rating and capacity tables.

POWER,

330 West 42nd St, New York, N. Y.

Please have the manufacturers send me without obligation, the literature circled below. (Numbers correspond to descriptive paragraph numbers.) Cut out this form and mail to *Power*.

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BE SURE TO PRINT YOUR NAME AND ADDRESS

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THE "GIFT OF GAB" WON'T KEEP A BOILER STEAMING

ADVERTISING adjectives abound in modern advertising but it takes a good external WATER SOFTENER properly chosen and fundamentally engineered by experienced men to keep a modern Steam Generator free of Scale, Deposit and the ravages of Corrosion.

We offer such equipment for your consideration. We will describe, simply and honestly, in forthcoming issues the Water Softeners which we manufacture.

● *Hot Process Lime Soda . . . Cold Process Lime Soda*
Zeolite Base Exchange . . . Cold Process Lime Zeolite
Clarification Filters . . . Blowdown Systems

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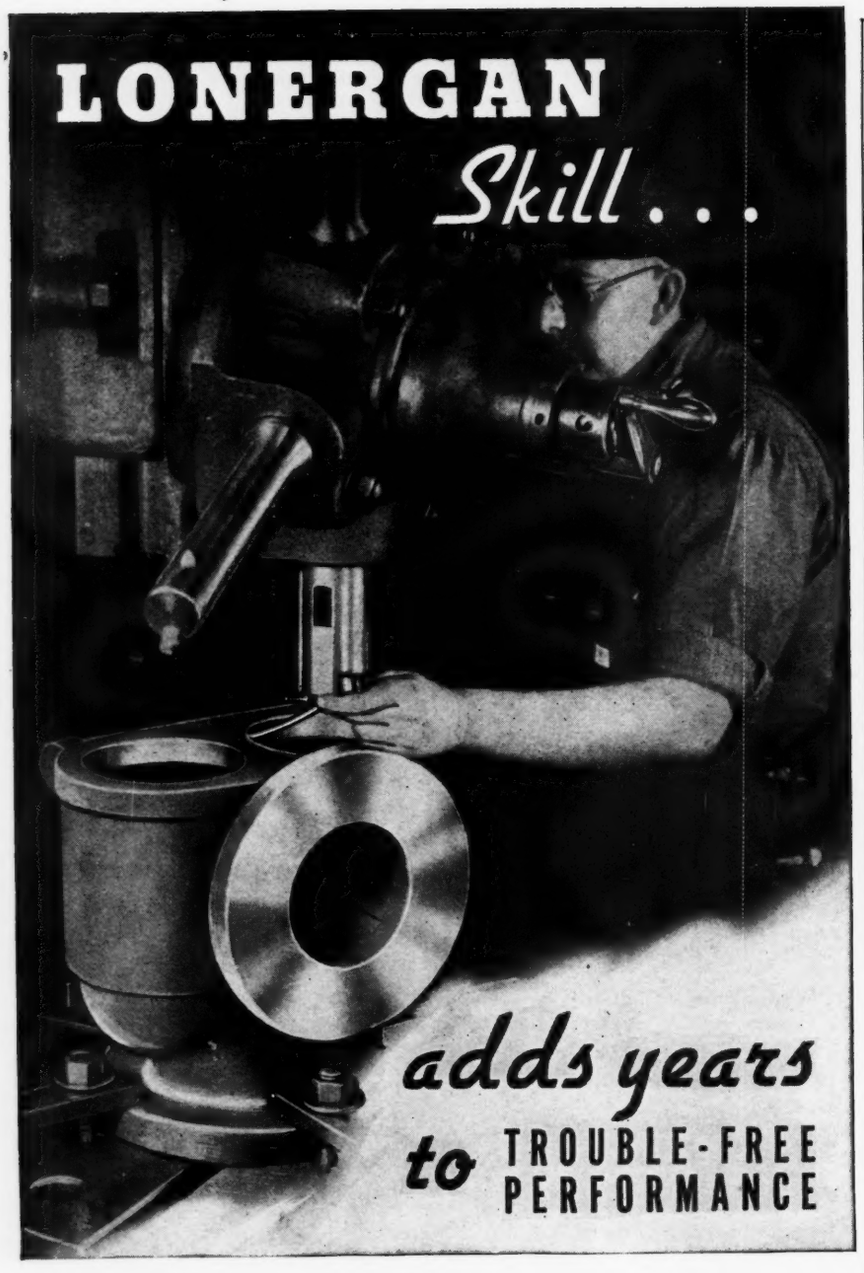

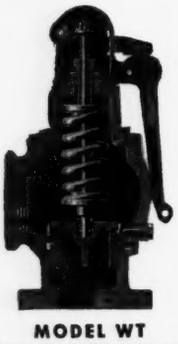

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POP SAFETY VALVE

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300 Specialties for Power Plants Standard Since 1872

Lonergan VALVES · GAUGES · SPECIALTIES ·

STRAWS

(continued from page 100)

COLORADO—Uncompahgre Valley Water Users' Assn, Montrose, plans hydroelectric plant on South Canal of Uncompahgre Valley project with initial capacity of about 1200-kw. Bureau of Reclamation, Denver, will supervise project.

La Junta is considering early special election to vote bonds for $700,000 for proposed municipal electric plant, including distributing lines.

DELAWARE — Hercules Powder Co, Delaware Trust Bldg, Wilmington, will award contracts soon for steam power house at plant at Brunswick, Ga. Cost close to $70,000.

FLORIDA — Neptune Beach plans two motor-driven pumping units of 750 gpm capacity, and two diesel-driven pumps, same capacity. Also will purchase 100,000-gal. elevated steel tank on 110-ft steel tower. Entire project to cost about $91,300.

GEORGIA — Schools Boards of Albany, and Dougherty County, Albany, plan central-heating plant in new junior high school. Cost about $200,000.

Camilla Ice & Cold Storage Co, Camilla, contracted York Ice Machinery Co for ice-manufacturing and refrigerating machinery to replace obsolete equipment in plant.

Wayne County Ice & Storage Co, Jesup, has acquired local ice-manufacturing and refrigerating plant of Jesup Ice Co, and will remodel and improve.

IDAHO — Independent School District No. 12, Benewah County, Plummer, plans central-heating plant in 2-story high school. Cost about $70,000. George M Rasque & Son, Washington Trust Bldg, Spokane, Wash, architects.

ILLINOIS — Board of Education, Chicago, plans central-heating plant in new multi-story high school, Norwood Park. $1,387,000 arranged. Construction will be carried out in 1938.

Board of County Supervisors, Chicago, plans central-heating plant in new 2-story and basement county sanitarium on 22-acre site in Lake County. Cost about $400,000.

Swift & Co, Union Stock Yards, Chicago, plans boiler house at new meat-packing plant at Asheville, N. C., for which bids will be asked soon. Cost about $100,000.

INDIANA — Board of School Trustees, Anderson, plans central-heating plant in new 2-story high school. Cost about $200,000.

Huntington has engaged Burns & McDonnell Engrg Co, Kansas City, Mo, to make surveys and estimates of cost for extensions in central-heating plant.

Brandywine Township Board of Education, Greenfield, plans central-heating plant for school at New Palestine, Ind. Ohmer Gordon, Greenfield, architect.

Enos Coal Co, Oakland City, plans rebuilding of portion of coal-mining plant at local properties, recently damaged by fire. Loss about $40,000 with equipment.

La Porte County Cold Storage Co, La Porte, has acquired building at 405 Tyler St., and will remodel and equip for cold-storage and refrigerating plant.

Board of School Trustees, Brownstown, plans central-heating plant in new 2-story consolidated high school. Cost about $100,000.

IOWA — Construction Service, Veterans' Administration, plans boiler plant at institution at Knoxville. Bids will be asked soon.

Maquoketa has low bid from Tubba Construction Co, Maquoketa, for improvements in municipal power-plant building at $16,144. Contracts for new equipment will be placed soon. Cost about $90,000.

Hopkinton plans municipal electric plant, and will proceed with project early in spring. Previous injunction against construction has been dismissed by Supreme Court. Cost about $66,000. A S Harrington, Baum Bldg, Omaha, consulting engineer.

When rustable piping needs replacement...cut your annual COST with Anaconda Copper Tubes

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Anaconda Copper Tubes are phosphorous-deoxidized to increase corrosion resistance and improve physical properties.
Anaconda Fittings have deep cups to give long, strong bonds and more support for tubes.

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Plumbing: Hot and cold water lines. Fire sprinkler systems.

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Refrigeration and Air-Conditioning: Refrigerant circulation lines. Humidifying apparatus.

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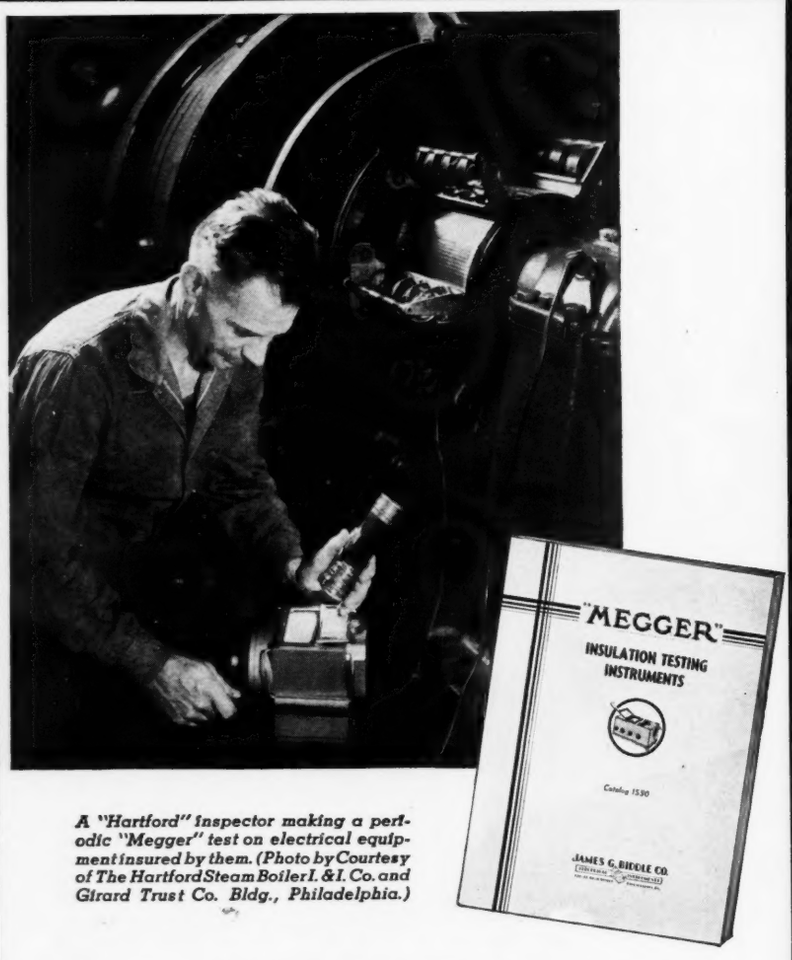

A "Hartford" inspector making a periodic "Megger" test on electrical equipment insured by them. (Photo by Courtesy of The Hartford Steam Boiler I. & I. Co. and Girard Trust Co. Bldg., Philadelphia.)

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Our new "Megger" Catalog—just issued—describes the most complete line of instruments ever offered for testing electrical insulation resistance. It tells just what the "Megger" instruments are—the various types that are available—and why they are so widely used for testing practically all types of electrical equipment. It describes, illustrates, suggests—is dedicated to the detection and prevention of trouble.

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ELECTRICAL INSTRUMENTS

1211-13 ARCH STREET PHILADELPHIA, PA.

L H Hatch, Alta, heads project to construct and operate a cold-storage and refrigerating plant on local site. Cost about $35,000, with equipment.

Lamoni will begin work soon on municipal power plant, including two diesel-generator units and accessory equipment, for which contract has been let to Fairbanks, Morse & Co, Chicago. Cost about $100,000.

Waukon plans municipal gas plant and distributing system. Surveys and estimates of cost will be made by Gas Engineering Corp, Des Moines.

Cresco has authorized surveys and estimates of cost for new municipal gas plant and distributing system. Gas Engineering Corp, Des Moines, engineer.

KANSAS — Stafford is considering extensions in municipal power plant, including 450-hp diesel-generator and auxiliary equipment. Surveys have been made by Paulette & Wilson, 1006 Kansas Ave., Topeka.

KENTUCKY — Owensboro plans improvements in municipal electric plant. Cost about $27,000. Elmer Smith, chief engineer, in charge.

LOUISIANA — Public Building Branch, Treasury Dept, plans extensions in boiler plant at National Leprosarium, Carville.

Skrmetta Seafood Co, 2223 Clis St, New Orleans, plans boiler house at new canning plant at Cameron. Cost over $40,000.

Hammond is considering municipal power plant. James M Fourmy, city engineer, in charge.

White Wood Products Co, Bogalusa, operated by White Brothers Co, plans boiler house at new woodworking plant at Hammond.

Benton contracted Fairbanks, Morse & Co for turbine-pumping machinery and accessories for municipal water system; also, let contract to Pittsburgh-Des Moines Steel Co for 50,000-gal. elevated steel tank and tower.

Public Building Branch, Treasury Department, plans central-heating plant in 10-story Federal office building on South St, New Orleans, for which bids will be asked in spring. Cost $2,550,000.

MAINE — Central Maine Power Co is rebuilding dam of International Paper Co mill at Solon, at a cost of $300,000. 10,000 hp will be added to available supply. The dam, a 40-year-old log structure, is being reconstructed in concrete.

MARYLAND — Hagerstown contracted J B Ferguson & Co, Hagerstown, for building for municipal power plant at $51,500. Awards for equipment will be made soon. Cost close to $200,000. Wood & Kirkpatrick, Stock Exchange Bldg, Philadelphia, Pa, consulting engineers.

MASSACHUSETTS—Ashland plans motor-driven water-pumping station and steel standpipe near Homer Ave. Proposed to arrange fund in March.

Needham plans pumping station for municipal sewerage system, with motor-driven pumping units and accessories. Project scheduled to mature in March.

MICHIGAN —City Council, Lansing, has awarded general erection contract to R C Mahon Co, Detroit, for addition to municipal power plant, which will require about 1,500 tons of structural steel shapes, at a price of $145,512. Entire project will cost approximately $3,000,000, with turbine-generator, boilers and auxiliaries.

Menominee will begin work soon on municipal power plant. Cost $880,000. Financing through Federal aid. Francis Engineering Co, Saginaw, consulting engineer.

Traverse City plans extensions in municipal power plant. Cost about $65,000. Hamilton & Webber, Grand Rapids, consulting engineers.

Board of County Commissioner, Menominee, plans installation of stoker in central-heating plant at local court house. Derrick Hubert, 1065 Sheridan Rd, arichtect.

MINNESOTA — Minneapolis Gas Light Co, Minneapolis, is arranging fund of about $430,000 for extensions in 1938, of which about $67,000 will be used for gas-plant improvements, $104,000 for extensions in

THE *Higher* THE TEMPERATURE THE MORE YOU NEED CHAPMAN POWER PLANT VALVES

High Pressure Steam Valve with Welding Ends, Equipped with Chapman Motor Unit.

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Carbon Molybdenum Steel.
Chrome Nickel Steel.
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Chrome Tungsten Steel.
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You'll never find a Chapman Valve wanting when it comes to high rating power plant service. For into these all steel valves goes the sturdy stock that guarantees success. Raw materials used are carefully chosen and checked. Each melt of the special steels is poured in our own foundries under the watchful eyes of our metallurgists. The castings of these proven metals are machined to the highest point of precision. And each part—***each valve***—is inspected and tested before it goes out in the world.

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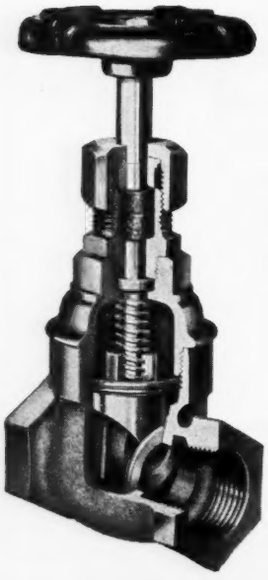
When ordinary valves reach retirement and are ready for the scrap heap, Fairbanks Renewable Valves are not even approaching "middle age." And here's why.

Fairbanks Renewable Valves can be renewed year after year without removing them from the pipe line. In fact, they last as long as the pipe line itself.

It is only human nature to discard leaky valves instead of fussing to reface them or make hard repairs. And, of course, non-renewable valves must be scrapped when worn.

But it is so much easier and quicker to put a new seat or wedge in Fairbanks Renewable Valves that workmen naturally prefer to insert new parts.



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distributing pipe-lines, $115,000 for compressors and other operating equipment and facilities, and $86,000 for new meters and service installations. Harry K Wrench, vice-president and general manager.

Plainview Co-Operative Creamery Assn, Plainview, is at head of project to construct and operate a local cold-storage and refrigerating plant. Cost over $45,000.

Sandstone Farmers' Co-Operative Creamery, Sandstone, plans cold-storage and refrigerating plant. Cost over $40,000.

Farmers' Storage Co, Minneapolis, contracted Scandroli Construction Co, Rockford, Ill., for remodeling and improving a building at Rockford, to be equipped as a cold-storage and refrigerating plant.

Westbrook plans municipal power plant. Bond issue of $78,200 is being arranged. Buell & Winter Engrg Co, Sioux City, Iowa, consulting engineer.

Glenwood is arranging bond issue of $200,000 for municipal power plant. Bids will be asked soon for engine-generator units and accessory equipment. Burlingame, Hitchcock & Estabrook, Sexton Bldg, Minneapolis, consulting engineers.

MISSISSIPPI — Farmers' Co-Operative Assn, Magee, plans boiler house at new local commercial fertilizer plant. Cost close to $30,000.

Yazoo City contracted Riley Stoker Corp for boiler, stoker and accessories at municipal power plant, at $43,550.

Monticello Veneer & Plywood Box Co, Monticello, plans rebuilding of boiler plant at mill, recently destroyed by fire. Loss close to $30,000.

MISSOURI — State Cancer Commission, Metropolitan Bldg, St. Louis, Dr. Ellis Fischel, chairman, plans boiler plant at new multi-unit state cancer hospital in vicinity of Columbia. Cost about $500,000. Jamieson & Spearl, Arcade Bldg, St. Louis, architects.

St. Charles plans steam power house in connection with new city hall building, for which a fund of $100,000 has been secured.

La Plata contracted Monroe Electric Co, Chicago, Ill., for municipal power plant and distributing system at $100,000. E T Archer & Co, New England Bldg, Kansas City, Mo., consulting engineers.

Board of Public Service, St. Louis, will award contracts soon for engines, generators, pumps, piping and other equipment for improvements in power house at Koch Hospital. William C E Becker, chief engineer, Dept of Bridges and Buildings, City Hall, in charge.

Trenton, contracted Ebbe Construction Co, Trenton, for new municipal power-plant building. Installation will include three 430-kw diesel-generator units and auxiliary equipment, for which awards have been made. Cost about $315,000.

MONTANA—Havre contracted J L McLaughlin Co, Great Falls, for municipal natural-gas distribution system, at $144,652, including pipelines, control station, etc.

NEBRASKA — Blair will take bids soon for extensions in municipal power plant, including new engine-generator unit and auxiliary equipment. Black & Veatch, 4706 Broadway, Kansas City, Mo, consulting engineers.

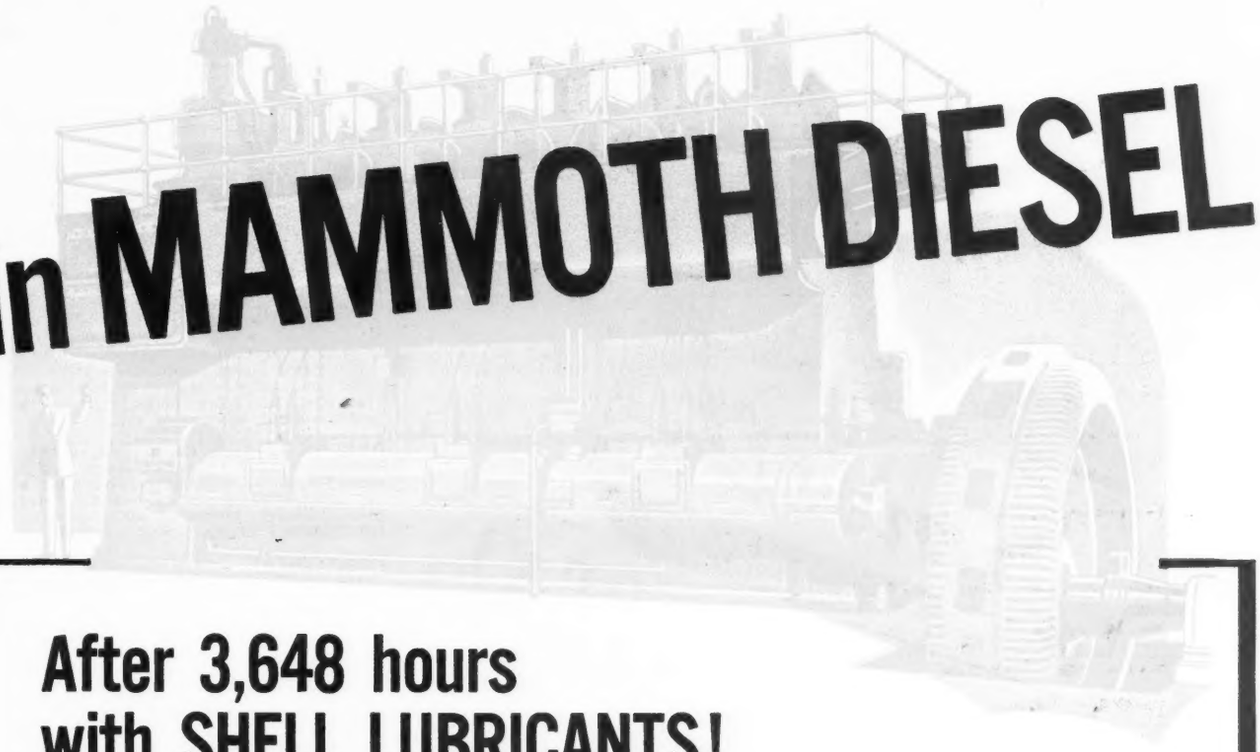
Fairbury has authorized purchases of equipment for extensions in municipal power plant. Cost about $150,000. Financing through Federal aid. Robert Fulton, 2327 South 19th St, Lincoln, consulting engineer.

York is considering early special election to approve project for a municipal power plant.

NEW HAMPSHIRE — Gonic Manufacturing Co, Rochester, has installed a large General Electric turbine-generator, purchased from a government plant in Englewood, Md. Added equipment will enable plant to produce all its own power.

NEW YORK — Frank E Holmes, care of Laurence Adikes, 153–01 Jamaica Ave, Jamaica, L. I., N. Y., heads project to construct and operate 6-story and basement cold-storage and refrigerating plant on 94th Ave. Plant will total about 1,300,000 cu ft, and is estimated to cost close to $600,000, with equipment.

Only .002" cylinder wear in MAMMOTH DIESEL



After 3,648 hours with SHELL LUBRICANTS!

IN 1935, the Carthage, Missouri, Water and Electric Plant found that its three Diesel engines no longer had sufficient generating capacity to meet the city's growing requirements for light and power. They went to the Nordberg Manufacturing Company with their problem.

As a result, the Board of Public Works of the City of Carthage contracted with Nordberg for one of their new model 2,250-horsepower TS-216's then being developed and tested in the Milwaukee factory.

With the first development of this enormous new Diesel, Shell engineers closely analyzed its lubrication requirements—called on Shell's wide resources and experience to find the ideal lubricant. Exhaustive block tests proved the exceptional performance of Shell Talpa Lubricating Oils. The new Diesel engine was placed in operation in Carthage, its pistons cooled, its bearings and cylinders lubricated by Shell products—100%.

For 3,648 hours this new Diesel engine ran continuously at the Carthage plant. Then the big engine was stopped and its pistons were pulled for inspection.

All oil rings and ring grooves were found to be mechanically free and without a trace of deposits. Most remarkable, after 3,648 hours of operation, cylinder wear was found to be less than .002 of an inch—almost unheard of in an engine of this size!

* * *

This "success story" of a great Diesel engine and a great lubricant is important to you. For it is a story that is being repeated day after day in mills, mines and factories all over the United States. Shell brings to your problem a "plus" in lubrication: The finest lubricants being refined today, plus resourcefulness born of practical experience. To avail yourself of this service, write or phone your nearest Shell office.

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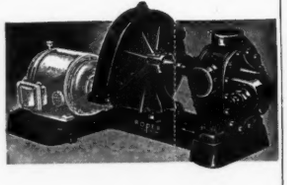
Flawless coordination, complete balance and perfect rhythm—plus experience—makes the ski jumper a smooth performer.

Smooth PERFORMERS!



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Roper Pumps are smooth performers—they are easy to install, easy to service—their original cost is low, upkeep the lowest.

You can depend upon Roper Pumps to do a two fisted job without any pampering. Use Ropers wherever DEPENDABLE pumps are needed. Capacities 1 to 700 gallons per minute.

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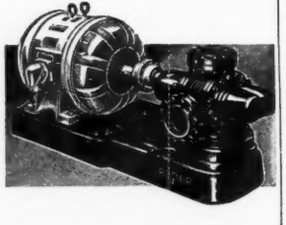
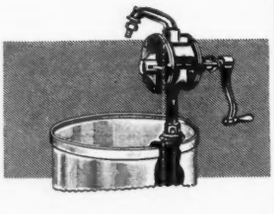




ROPER Rotary PUMPS

DEPENDABLE - SINCE 1857

OHIO — United States Engineer Office, Louisville and Ohio River Div, Cincinnati, plans motor-driven pumping machinery and accessories, and flood gates, estimated to cost $1,200,000, in connection with dam and levee in vicinity of Paducah, Ky., forming part of Ohio Valley flood-protection program. Entire project will cost about $5,400,000.

Cincinnati, C O Sherrill, City Hall, city manager, plans central-heating plant in connection with municipal garage, service and repair building. Cost about $250,000.

Thompson Printing Co, 442 E 2nd St., Dayton, plans improvements in boiler house at plant at Tippecanoe City, including new boiler units, stokers and auxiliaries.

OKLAHOMA——Miami plans diesel-generator unit and auxiliaries in municipal power plant.

Board of Directors, Masonic Lodge, Bartlesville, contracted W R Grimshaw Co, Philtower Bldg, Tulsa, for air-conditioning plant in new 9-story office building, to cost over $100,000.

National Mutual Casualty Co, Commercial Bldg, Tulsa, plans air-conditioning plant in multi-story office building. Bids will be asked soon.

Construction Service, Veterans' Administration, will award contract soon for boiler plant for auxiliary service at institution at Muskogee, including boiler units, pumps, safety-control apparatus, etc.

OREGON — State Capitol Reconstruction Commission, State Capitol, Sales, A J Bassett, secretary, will award contract soon for extensions in central-heating plant at State Library, including boiler and auxiliary equipment. Cost about $65,000.

PENNSYLVANIA — Oscar Nebel Co, Hatboro, plans boiler house at new knitting mill at Staunton, Va. Cost over $75,000, with equipment.

O'Neil & Reidy, 260 West Washington St, Bradford, plan 6-in. welded-steel pipeline from natural-gas field district near Scandia, Warren County, Pa., to connection with main pipeline on Allegheny River, for natural-gas transmission. Cost close to $80,000.

TENNESSEE——Construction Service, Veterans' Administration, plans boiler plant at new hospital unit at Murfreesboro, where site is being acquired.

TEXAS — Texas Sea Foods, Inc. National Standard Bldg. Houston, plans refrigerating and quick-freezing plant in new 3-story branch cannery at Corpus Christi. Cost over $70,000. Henry S Hoddman, 3908 Main St, Houston, architect.

Wolff & Marx Co, West Houston St, San Antonio, contracted Charles G Heyne & Co, 2002 Rothwell St, Houston, for air-conditioning plant and system in department store.

Rockport contracted Gayle Brothers, 2808 Wentworth St, Houston, for municipal gas-distributing system at $42,604.

Electra has approved plans for municipal light and power plant, and will begin work in spring. Fund of $220,000 through Federal aid. J E Ward, Harvey-Snider Bldg, Wichita Falls, consulting engineer.

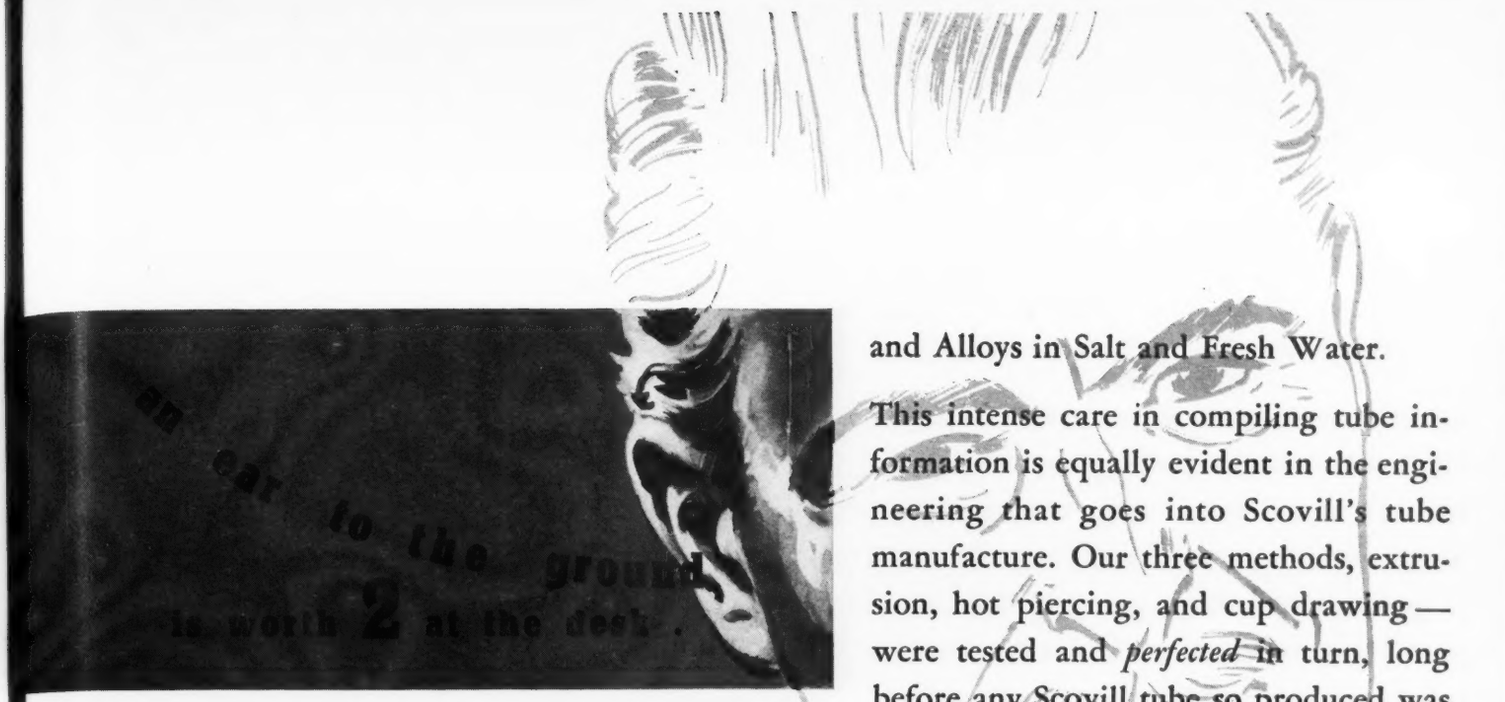
Hagy, Harrington & Marsh, Amarillo, plans installation of a compressor station at new carbon-black plant in vicinity of Guymon. Cost over $85,000.

UTAH — Wasatch Oil & Refining Co, Salt Lake City, Utah, plans power house and pumping station at new gasoline-refining plant at Pocatello, Idaho. Cost close to $100,000.

VIRGINIA — Bone Dry Fertilizer Co, Dock and 19th Sts, Richmond, plans boiler house in connection with rebuilding of plant recently destroyed by fire.

State Office Building Commission, State House, Richmond, plans central-heating plant and air-conditioning system in new multi-story state office building, totaling about 120,000 sq ft of floor space. Cost about $1,300,000.

Board of Education, Norfolk, plans central-heating plant in new 2-story Ocean View school. Cost about $200,000. Ferguson, Meakin & Moore, New Monroe Bldg, Norfolk, architects.



Countrywide, Scovill men for years have been leaving their desks to tap authentic sources of condenser tube information. Engineers like yourself, who experience the broadest possible variety of heat exchange conditions — have been their authority.

Today, thanks to your help, every Scovill representative is armed with a manual that contains probably more data on this subject than you can find anywhere else under one cover: 15 sub-sections devoted to the corrosion of metals and alloys, for instance. These range all the way from a discussion of "pH" values, through Common and Physical Properties of Tube Alloys and Common Metals, Galvanic Action, Corrosion Fatigue — to the Relative Resistance to Corrosion of Metals and Alloys in Salt and Fresh Water.

This intense care in compiling tube information is equally evident in the engineering that goes into Scovill's tube manufacture. Our three methods, extrusion, hot piercing, and cup drawing — were tested and *perfected* in turn, long before any Scovill tube so produced was put on the market.

And care for our customers is another Scovill fundamental. You receive periodic visits from a Scovill engineer whose only job is to help solve condenser tube problems.

These three factors — Engineering information — Engineering in production — Engineering as a service to you — *all* tend to create condenser tube life that will be longer than it might be without the Scovill background.

One Swift Change

Persistent failure of two rows of tubes in the first pass of a condenser (the tubes in adjacent areas were not abnormal) recently puzzled a power engineer. Scovill engineers working with him recommended one inexpensive construction change which entirely reduced the premature two row failure. Our experience coupled with your assistance solves problems like this.

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Yours for BOILER CONTROL

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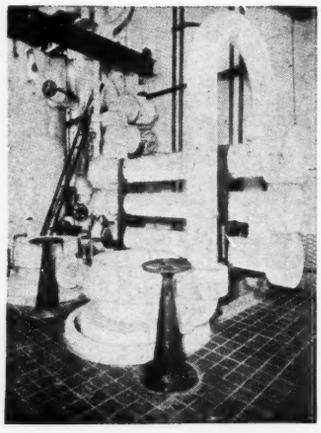
CONTINUOUS BLOWDOWN

This system offers complete automatic control of Boiler water impurities—eliminating the common boiler troubles of priming, foaming and the formation of scale. The outstanding feature of this system is the fact that this can be accomplished *without heat loss!*



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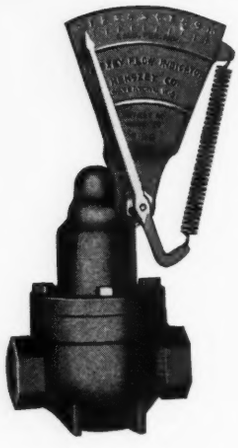
This accurate instrument goes right in the pipe line. Simple in construction and principle of operation, there are no complicated parts to get out of order. If water passes through, it must register—readings are from 0 to 100%.



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WATER METER

While this accurate meter is primarily designed to measure boiler feed water and blowdown, it has been successfully used with other liquids that are ordinarily difficult to measure.

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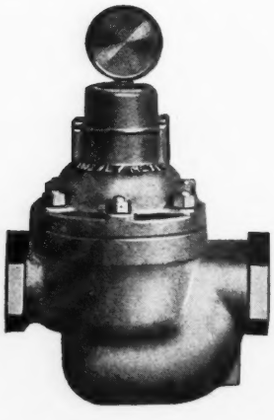
Send for further detailed information on any of above items.



HENSZEY COMPANY
Dept. D3 • Watertown, Wis.

Power Lines

(*Continued from page* 99)

R A HENDERSON, with Crane Co for 20 years, has been appointed manager of Oil Sales Section by W H Pape, manager of the Valve & Fitting Dept.

L W WALLACE, for the past three years director of engineering research for Assn of American Railroads, has been appointed director of Engineering and Research Div of Crane Co. All engineering activities of Crane Co were coordinated into this new division last December.

ARMIGER F DREDGE, for 12 years a member of Sargeant & Lundy, Chicago consultants and designers in power-plant engineering, has joined the staff of W Harry Archer & Associates, San Francisco consulting and industrial engineers.

FOLLOWING the resignation of Ernest E Wooler, chief engineer of Timken Roller Bearing Co, A L Bergstrom has been appointed executive engineer to coordinate some of the varied engineering activities of the company. Mr Bergstrom has been Timken chief works engineer the past several years.

JOSEPH A MESSENGER, formerly of United Engineers & Constructors Inc, has been appointed general manager of Buell Engineering Co, Inc. Mr Messenger has been in charge of UE&CI's Pipeline Construction Dept since formation of the company.

KARL A PAULY, for 39 years an industrial engineer with General Electric Co, has resigned. He will, however, continue in a consulting capacity.

EDWARD P POLLARD, for 46 years chief engineer of the Horn pumping station of Woburn, Mass. water-supply system, retired in January at the age of 80.

LEE M NELSON, superintendent of Hastings, Neb. municipal water and light system since 1933, has resigned to become superintendent of the electric-utility system at Rochester, Minn.

OBITUARIES

STANLEY G MURRAY, 59, a founder of Richardson Scale Co, Clifton, N. J., and its vice-president and chief engineer, died recently of a heart attack. Mr Murray was born in Gatehead, England, in 1879, and came to this country in 1903. He was an engineer with marked business and executive capacity, being highly regarded in the power-plant engineering field.

FRANK H METCALF, 69, president of Holyoke Valve & Hydrant Co, and for many years prominent in the textile-manufacturing industry of Massachusetts, died recently at Holyoke. He was a native of Hamilton, Ont., and attended Worcester Polytechnic Institute before entering industry.

WILLARD P CHANDLER, JR, 49, chief

INVINCIBLE

Allis-Chalmers Seal-Clad Motors are invincible to the enemies that attack ordinary motors.

Metallic dust, grit, oil, moisture, chemicals and other such destructive agents can be ignored when you purchase Allis-Chalmers Seal-Clad Motors . . . Also they are the sturdiest motors on the market—bar none.

Consider their invincible protection: the wound stator receives an impregnating treatment similar to the conventional type of winding. *But that's not all.* A Moulded Bakelite Shield, of high dielectric and mechanical strength, is fitted into a machined slot in the stator frame and tightly sealed into position with a special compound. Thus the coils are protected by hard, smooth shields that are invincible to the attacks of damaging agents.

Whatever the conditions in your plant, this additional protection will mean a great saving in the long run—and you get it at no additional cost.

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The Allis-Chalmers Mfg. Co. builds standard motors of every type from 1 hp. up—also motors for special application.

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MOTOR DIVISION

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SENIOR Tube Cleaner

does both jobs faster and better.

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ease in pump assembly

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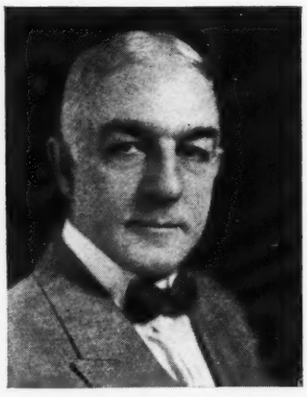
LAMINUM

Precision adjustment **SHIMS**

engineer, Industrial Div, Blaw-Knox Div of Blaw-Knox Co, died Jan. 24 at his home in Pittsburgh, Pa. Before joining Blaw-Knox in 1929, Mr Chandler was a member of the Heat Economy Bureau, and prior to that, respectively with Duquesne Steel Works and Clairton Steel Works of Carnegie Steel Co.

EDWARD R SHAW, 67, president of Technical Publishing Co and publisher of *Power Plant Engineering*, passed away at Barfield Sanatorium, Tucson, Ariz., Jan 12, after an illness of over



six months. Mr Shaw was born in 1870 in Corfu, N. Y., where services were held and interment took place Jan 18.

After school and some years in merchandising, he entered the business-publication field and joined the Taylor Publishing Co in 1903 on *The Engineer*. In 1908, when Technical Publishing Co was formed, Mr Shaw became president and business manager of *Power Plant Engineering*. In 1910 he went to Chicago, where he was active in the affairs of business-paper organizations in the succeeding years. Mr Shaw was one of the prime movers in forming the Associated Business Paper, Inc and the Audit Bureau of Circulation, serving on the Boards of Directors, as president of ABP for a term, and as treasurer of ABC almost since its foundation.

Long regarded as an outstanding figure in both the publishing and power-plant fields, Mr Shaw will be sorely missed by a wide circle of friends throughout the country.

BUSINESS ITEMS

25TH anniversary of the organization of Mechanical Goods Div, Goodyear Tire & Rubber Co, Akron, Ohio, was celebrated in February. Four outstanding veterans of the rubber industry who have been with the division since its inception, were honored at a dinner. The four, W M Metzler, Hal Campbell, D R Burr, and R R Peebles joined Goodyear in 1913.

WORTHINGTON PUMP & MACHINERY Co, Harrison, N. J., recently acquired an interest in Moore Steam Turbine Corp., Wellsville, N. Y. This association adds to list of products sponsored by Worthington an extensive line of steam-turbine equipment.

HANDY & HARMAN, New York, N. Y.,

GET MORE EFFECTIVE POWER TRANSMISSION

with V-BELT DRIVES AND SHEAVES

Profit by the experience of thousands of industrial users—get greater overall efficiency and better production control with Medart V-Belt Drives and Sheaves . . . They assure more effective transmission of power . . . Reduced belt expense . . . Uniform drive and positive speeds . . . Extreme flexibility . . . Fewer belt adjustments . . . Longer life . . . Vibration is minimized—both driving and driven machines run more smoothly . . . Especially adaptable to short center drives . . . Save valuable space.

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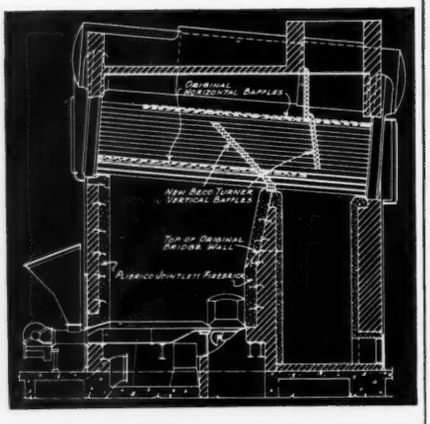
ORIGINAL HORIZONTAL BAFFLES
NEW BECO TURNER VERTICAL BAFFLES
TOP OF ORIGINAL BRIDGE WALL
PLIBRICO JOINTLESS FIREBRICK

with Beco-Turner VERTICAL BAFFLES

THE print above represents Beco-Turner vertical baffles as installed in connection with two 354 hp. horizontal boilers at La Measure Bros., Inc., the largest laundry in Detroit. The vertical baffles replaced old horizontal baffles which are also indicated in the print.

The installation of Beco-Turner baffles has effected a fuel saving of 20% in the operation of these boilers. It has likewise eliminated a serious smoke condition and excessive damage to the stoker parts and refractory linings while increasing maximum capacity. Mr. Walter Baker, C.E., is highly pleased with these results.

With horizontal baffles, approximately 25% of the tube surface does not come into direct contact with the flow of hot gases. Beco-Turner vertical baffles put practically the entire heating surface of the boiler to work. They increase capacity and efficiency; they decrease flue-gas temperature and fuel consumption.

Free Engineering Service

If you are operating horizontally-baffled boilers, our engineering department will gladly submit prints showing how your boilers can be easily and economically modernized by installing Beco-Turner vertical baffles. If you are operating other types of boilers, they will suggest any possible recommendations for improving the performance of your boilers through more advanced baffle and furnace design.

As for your copy of our handsome catalog covering Beco-Turner baffles. Send blueprints showing your existing baffle design for our recommendations. No obligation.

PLIBRICO JOINTLESS FIREBRICK CO.
Nation-Wide Boiler Setting Service
Baffle Wall Department
1818C Kingsbury St., Chicago, Ill.

BECO-TURNER BAFFLES

Meetings

American Society of Mechanical Engineers—*National Spring Meeting, March 23–25, Los Angeles, Calif. Also, Semi-Annual Meeting, June 20–24, St. Louis, Mo. C E Davies, secretary, 29 W 39th St, New York, N. Y.*

Midwestern Power Conference—*Sponsored by Armour Institute of Technology, April 13–15, LaSalle Hotel, Chicago, Ill. L E Grinter, dean of Graduate Div, Armour Tech, conference director.*

National District Heating Assn.—*Annual convention, June 28–July 1, Lord Baltimore Hotel, Baltimore, Md. W H Sanford, secretary-treasurer, 1317 Spruce St, Philadelphia, Pa.*

Western Metal Exposition and Congress—*Pan-Pacific Auditorium, Los Angeles, Calif., March 21–25. W H Eisenman, secretary, American Society for Metals, 7016 Euclid Ave, Cleveland, Ohio.*

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has formed a Metal Powder Products Div, which as the name indicates, will engage in development and manufacture of products fabricated from metallic powders.

ARMSTRONG-BRAY & Co, Chicago, has appointed Higgins & Linde, Inc, Chicago, as exclusive selling representative in the Middle West.

CUTLER-HAMMER, INC, Milwaukee, has organized Canadian Cutler-Hammer, Ltd, to manufacture motor and generator-control products for Canadian markets. The new company's address is 384 Pape Ave, Toronto 6, Canada.

WHEELCO INSTRUMENTS Co, Chicago, has appointed three new representatives: C I Gillen, 5026 Osage Ave, Philadelphia; H F Rehling, 933 South St., Boston; and R W Coward, 2400 Arlington Ave South, Birmingham, Ala.

FRANK E AURAND, JR, formerly associated with Concrete Surfacing Machinery Co, Cincinnati, has bought from that company the Berg Cleaning Tool Div, and will carry on this business as Aurand Mfg & Equipment Co, 2643 Colerain Ave, Cincinnati.

CLEES VALVE & ENGRG Co is installing a new boiler in its testing laboratories at Newark, N. J., to provide 2500-lb steam. This will supplement existing test equipment capable of supplying steam at 1500 lb sq in. and hydraulic facilities for tests up to 10,000 lb per sq in.

BROWN Co has moved the executive offices of its Tubular Products Div (electrical conduit) from Portland, Me., to 420 Lexington Ave, New York, N. Y.

TERRY STEAM TURBINE Co, Hartford, Conn., has appointed as representative R E Chase & Co, Tacoma Bldg, Tacoma, Wash., with branch offices in Seattle, Portland, and Spokane.

FOXBORO Co, Foxboro, Mass., has appointed Robert V Hamilton resident sales engineer in charge of Birmingham, Ala., district.

MCCLAVE-BROOKS Co, Scranton, Pa., has appointed Walter Scott Elder, 431 S Dearborn St, Chicago, sales engineer for central and northern Illinois, eastern

Seal Joints TIGHT with a daub of SEAL-ALL

. . . the plastic jointing compound that:

Cuts Labor Costs
Reduces Maintenance Costs
Withstands Highest Pressures
. . . Won't Blow Out!

For sealing turbine joints, flanges and threads, with or without gaskets, hemp, etc.

Used by leading Power Plants, Ship Builders, Steamships, Railroads, U. S. Navy, Public Utilities, and wherever tightly sealed joints are vital. Write for full details.

Daub it on!

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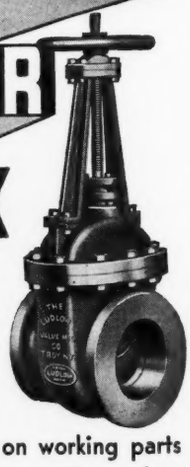
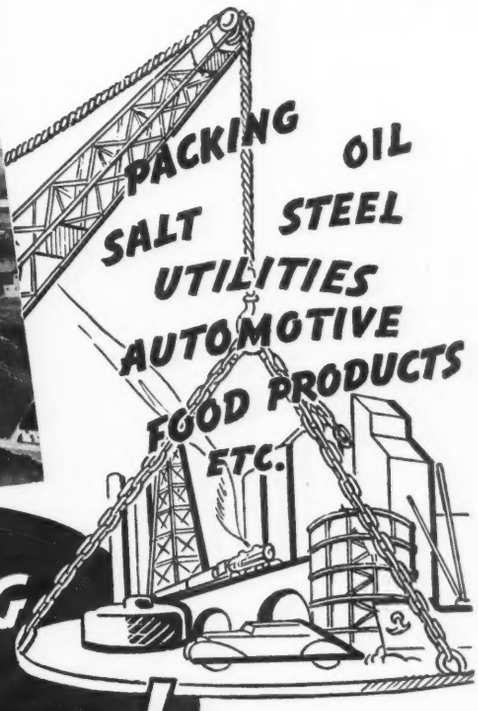


• If you wish longer valve life—install Ludlow Steam gate valves. The famous Ludlow wedging principle saves wear on working parts — means fewer replacements — gives more positive closure. These valves take pressure on either side of the gate and may be repacked when fully open. Furnished with flanged or screw ends — all iron or iron with bronze mounting types.

The LUDLOW VALVE MFG. COMPANY
TROY . . . . NEW YORK



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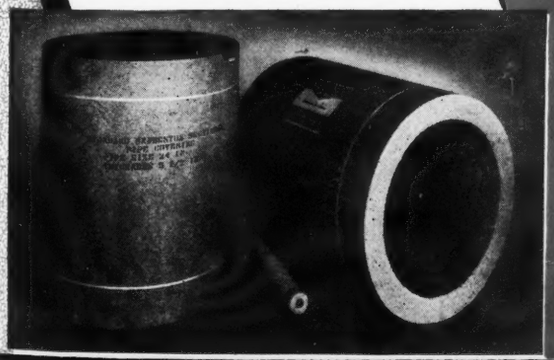
- Sectional Insulation for *ALL* pipe sizes.
- Adaptability to Higher Temperatures.
- Permanent High Efficiency.
- No Shrinkage.
- Unaffected by Water or Moisture.
- Great Structural Strength.
- Proof Against Vibration, Handling and Abuse.
- Light Weight.
- Low First Cost.
- Simplified Application.
- Maximum Return on Investment.



Have you ever seen sectional pipe insulation of this size? It is for 24" pipe, a standard size in the Unibestos line.

The modern HEAT INSULATION that is making new highs in insulating efficiency in plant after plant — *everywhere!*

A new day has come in insulation practice, bringing with it new conceptions of economy and durability, under the increasingly severe conditions of modern power production.

Old style fragile insulations are fast being superseded by modern Unibestos, with resulting savings in application and maintenance costs and higher actual insulating efficiencies—assuring a heretofore unheard-of return on the dollars invested.

Prominent concerns around the country have found this out—leaders in every line of industry, from salt to steel—from milk to motor cars. Orders have brought re-orders. Today the amazing performance records of Unibestos have become the talk of the trade. The facts are at your service. Catalog on request.

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UNION ASBESTOS AND RUBBER CO.

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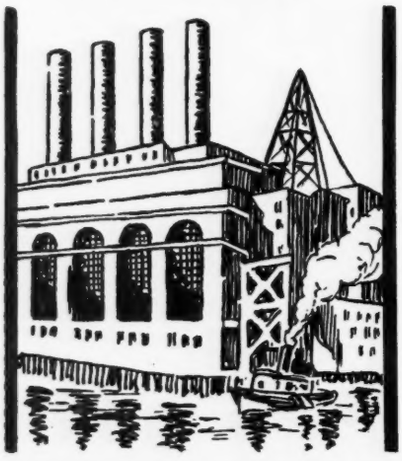
INSULATIONS — PACKINGS — ASBESTOS TEXTILES — FRICTION MATERIALS

FUEL COSTS UP 25%



COMBUSTION TRAINED BOILER ROOM MEN

actually lower fuel costs and increase boiler efficiency notwithstanding rising costs.

Our 23rd Year

For 23 years the Hays Institute has helped power plant men advance, has cut fuel costs and has increased efficiency in hundreds of leading Utility and Industrial Plants, thru its NON-TECHNICAL—PRACTICAL—HOME STUDY COURSE IN FUEL AND COMBUSTION ENGINEERING.

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	Men Enrolled
Armour and Company	66
Stone and Webster	93
Erie City Iron Works	16
Commonwealth Edison Co.	126
E. I. du Pont de Nemours Co.	45
Corn Products Refining Co.	27
Standard Oil Company	21
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Iowa, southern Wisconsin, and northern Indiana.

J J Sleain and V A Tilden have been appointed assistant sales managers of Graton & Knight Co., Worcester, Mass., and A M Walsh has been named sales-promotion manager.

Morris Machine Works, Baldwinsville, N.Y., has appointed The Lang Co as representative for Salt Lake City, Utah, with offices at 267 W 1st South St.

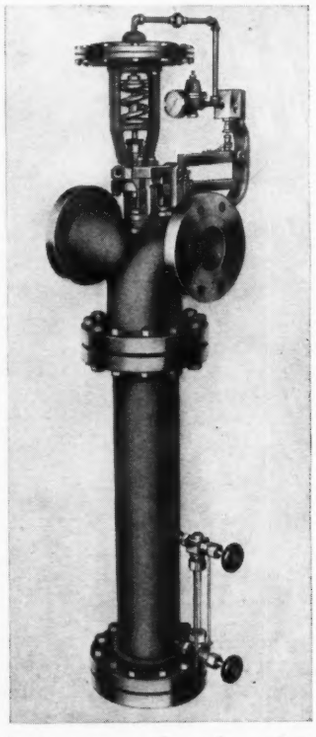
Iron & Steel Products, Inc, Chicago, Ill., recently obtained the services of Louis H Dimick, formerly with Clapp, Riley & Hall Equipt Co, and C William Benz, formerly with Cudahy Packing Co.

New Equipment

(*Continued from page* 114)

Desuperheater

Operates on steam from 212 to 1100F, maintaining within close limits desuperheated-steam temperature. Flow of cooling water is controlled at spray nozzle.



Constant pressure drop is maintained across nozzle, permitting continuous supply of cooling water to be sprayed into superheated steam in proportion to demand, from minimum to maximum flow. Boiler feedwater can be used as cooling water. Air or water can actuate pilot operator of water-control valve.

Northern Equipment Co, Erie, Pa.

Pressure Lubricator

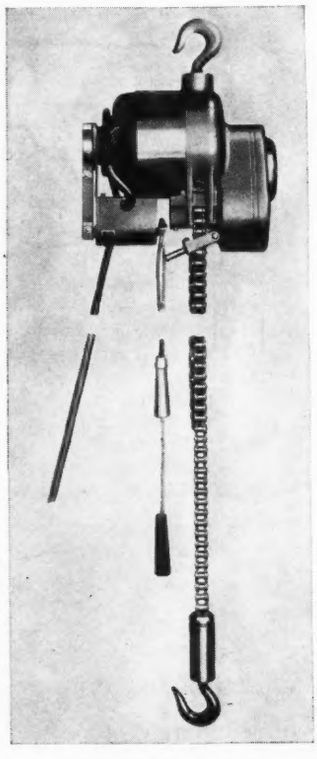
"Acco-Morrow" pressure lubricator supplies pressure up to 1000 lb. "Oilingseal" tip, made of compressible composition, makes a pressure-tight contact on top

edge of any common oil hole and practically all sizes and types of cups and oil-hole covers in general use. Plunger in bottom of unit furnishes pressure.

American Chain & Cable, Inc, York, Pa.

Portable Electric Hoist

"Budgit" portable electric hoist of 500 lb lifting capacity weighs complete 58 lb. Operating from lighting sockets, no additional wiring or special conductor



systems are required. Regularly equipped with sufficient lifting chain to give a lift of 10 ft; additional lift is possible by lengthening chain. Lifting speed with 500-lb load is 17-fpm. Roller chain is employed instead of usual link chain.

Shaw-Box Crane & Hoist Div, Manning, Maxwell & Moore, Inc, Muskegon, Mich.